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MASABA, INC. (d/b/a MASABA Mining Equipment)

TERMS AND CONDITIONS

1. **OFFER & ACCEPTANCE:** MASABA, Inc. ("Seller") acceptance of Buyer's order to purchase products is expressly made conditional on assent to these Terms and Conditions, which along with the Sales Order constitute a binding "Contract" between the parties. This Contract constitutes the complete and final agreement between Seller and Buyer for the products. Any additional or different terms or conditions contained in any document furnished by Buyer, including but not limited to, any purchase order or any acknowledgement, are deemed to be material and are herby objected to and rejected by Seller. If such agreement shall be deemed an offer or counter-offer by Buyer, Seller expressly rejects such offer or counter-offer and limits acceptance to these Contract terms and expressly objects to any different or additional terms proposed by Buyer. Any actually performance by Buyer or Seller thereafter shall be deemed a renewal of the offer contained in this Contract and acceptance of this Contract without change. In the event of a conflict between the terms of this Contract and the terms of any other document, the terms of this Contract shall control. This offer to purchase Seller's products is valid for thirty (30) days form the date of the Sales Order.

2. **PAYMENT TERMS:** All prices specified in this Contract are FOB Seller's designated location which constitutes delivery. All risk of damage to or loss of the products from any cause whatsoever shall pass to Buyer upon delivery, even if Seller arranges for shipment of the product. Unless otherwise expressly provide on the reverse hereof, payment shall be made within thirty (30) days form the earlier of the date of delivery or the date of an invoice, without discount. Any discount which may be expressly provide on the reverse hereof applies to the sale price of the products at the shipping point, and does not apply to any charges made for taxes, storage, loading or transportation. All payments shall be made in United States dollars. Interest will be charged at the rate of eighteen percent (18 %) per annum, or the maximum interest rate allowable by applicable law, whichever is lower, on all unpaid invoices. Buyer shall pay all taxes and charges of any nature imposed by any federal, state, or local governmental authority by reason of the sale or delivery of the products whether levied or assessed against Seller, Buyer, or the products. Such applicable taxes or charges, if not included in this Contract, shall be invoiced separately. If, in Seller's opinion, reasonable doubt exists as to Buyer's financial condition, Seller may, at any time and without prejudice to any other remedies, suspend or terminate performance of any order, decline to ship, stop any material in transit, or require full or partial payment by Seller in advance.

3. **DELIVERY:** Any delivery of promise date indicated on the Sales Order is an estimate of the date Seller believes the products will be available for delivery, provided, however, Seller shall not be responsible for any delays in delivery.

4. **WARRANTY**:

- **Limited Warranty; Exclusion of Third Party Components:** Subject to the terms, conditions and limitations contained herein, Seller warrants only to the original Buyer that (a) Seller's new equipment products and Seller's new component products will not fail to operate in accordance with their respective specifications due to the defects in material or workmanship during the period which ends two (2) years form the date of delivery, normal wear and tear excluded, and (b) Seller's new equipment products will not incur a failure of their respective structural components (i.e. , trusses) due to defects in material or workmanship at any time during the period which ends five (5) years form the date of delivery, normal wear and tear excluded. The foregoing periods are sometimes referred to as "original warranty periods." **THE FOREGOING LIMITED WARRANTY DOES NOT APPLY TO ANY PART, PORTION OR COMPONENT OF ANY PRODUCT WHICH IS MANUFACTURED BY A THIRD PARTY ("Third -Party Component")**.

- **DISCLAIMER OF ALL OTHER WARRANTIES, EXPRESS, IMPLIED OR STATUTORY:** THE LIMITED WARRANTY SET FORTH IN THE FOREGOING PARAGRAPH IS THE SOLE AND EXCLUSIVE WARRANTY. WITH RESPECT TO THE PRODUCTS, SELLER MAKES NO OTHER EXPRESS WARRANTY OF ANY KIND OR NATURE AS TO THE PRODUCTS OR THEIR PERFORMANCE EXCEPT FOR THOSE LIMITED WARRANTIES EXPRESSLY SET FORTH IN THE FOREGOING PARAGRAPH AND SPECIFICALLY DISCLAIMS ANY AND ALL REPRESENTATIONS OR WARRANTIES OF ANY KIND OR NATURE CONCERING THE PRODUCTS, INCLUDING, BUT NOT LIMITED TO, ANY REPRESTATIONS OR WARRANTY THAT THE PRODUCTS COMPLY WITH ANY LAW, RULE OR REGULATION. SELLER MAKES NO WARRANTIES WITH RESPECT TO ANY THIRD PARTY COMPONENT AND SELLER SPECIFICALLY SELLS SUCH THIRD-PARTY COMPONENTS "AS IS" WITHOUT ANY WARRANTY. **FURTHER, SELLER MAKES NO IMPLIED WARRANTY OF ANY KIND OR NATURE WITH RESPCT TO ITS PRODUCTS OR ANY THIRD-PARTY COMPONENTS AND SPECIFICALLY DISCLAIMS ANY AND ALL IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, ANY AND ALL IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, NON-INFRINGEMENT, OR COMPLIANCE WITH ANY FEDERAL, STATE OR LOCAL LAW, RULE OR REGULATION.** IN ADDITION, SELLER EXPRESSLEY DISCLAIMS TO THE FULLEST ALLOWED BY LAW, RULE OR REGULATION ANY WARRANTY PROVIDED UNDER ANY FEDERAL, STATE OR LOCAL LAW, RULE OR REGULATION.

- **Terms and Conditions of Warranty; Voiding of Warranty; Notice Requirements:** The limited warranties set forth above shall be null and void if (a) any alternations or modifications are made to a product, (b) a product is not maintained in strict compliance with the maintenance requirements set forth in the maintenance manual for such product or otherwise provided to Buyer of such product, (c) any repairs are made to a product which are not authorized by Seller in writing, (d) any failure of a product to comply with the above limited warranty is not reported to Seller in writing within thirty (30) days of the date such failure first occurs, (e) a product is operated after the failure covered by warranty first occurs, (f) a product is used for any purpose other than for the purpose for which it was manufactured, (g) a product is not operated in strict compliance with the terms and conditions set forth in any operating manual for the product (including, but not limited to exceeding the load bearing capacity of the product), (h) a product is abused or damaged, (i) Buyer fails to deliver the product to Seller for inspection and testing if requested by Seller or Buyer disposes of the product or any part of component on or before the sixtieth (60^{th}) day after sending a written claim to Seller, or (j) such failure of the limited warranty results from a failure of any Third-Party Component.

- **Course of Dealing; Course of Performance; Usage of Trade:** No course of dealing or course of performance of Seller with respect to the products sold under this Contract or with respect to any of its products to whomever sold and no usage of trade shall be considered in interpreting this Contract or any part thereof and none of the foregoing shall be considered a waiver or modification of any such terms, conditions, disclaimers, or limitation of the limited warranties or disclaimers contained in this Contract. No statement, whether written or oral, made by any employee, sales person, distributor, agent or contractor of Seller which is not set forth in this Contract shall be considered a representation or warranty with respect to any product, its specifications or its performance sand all such statements are hereby disclaimed.

- **Exclusive Remedies for Breach of Warranty:** The sole and exclusive remedy for any failure of any product to comply with the limited warranty set forth above or any other warranty imposed upon Seller by law, if any, shall, at the election of Seller, in its sole discretion, be either (a) the repair or replacement of the product or component which failed to comply with such warranty or (b) the refund of the purchase price of the product. Buyer is responsible for all labor costs in connection with the repair or replacement of any equipment or component product; however, Seller will be responsible for its own labor performed in connection with any repair of equipment products at Seller's location. Except as provideD below, any repair or replacement shall carry the same warranty as the original product but only for the remainder of the original warranty period. Buyer's exclusive remedy with respect to any claim arising out of or as a result of Third-Party Component shall be against the third-party manufacturer.

- **Warranty Claims; Notice Requirement; Limited Time to ring Claims:** Any and all claims under the above limited warranty shall be made to Seller only in writing and not later than thirty (30) days after the date the product first fails to comply with the above limited warranty but in no event later than the expiration of the original warranty period with respect to which the claim is being made. Any claim under the above limited warranty made after such period for making a claim shall be null and void. After receipt of written notice of the warranty claim, Seller shall determine whether to (a) repair or replace the product or part or (b)

refund the purchase price of the product. Seller may require Buyer to return any product or part thereof which Buyer claims to be defective to Seller at Buyer's cost for inspection as a condition to any claim under the above limited warranty. No product or part may be returned to Seller without Seller's prior written authorization. If a product which is returned is determined by Seller in its sole discretion not to have failed to comply with the limited warranty, Buyer shall pay costs of removal, repair and/or replacement for such product. If a product which is returned is determined by Seller in its sole discretion to have failed to comply with the limited warranty, Seller shall pay for all repair and/or replacement costs for such product (or refund the purchase price if so elected by Seller) and Seller shall reimburse Buyer for the reasonable costs of shipping the product or component to Seller.

- **Limitation on Liability for Breach of Warranty and Other Claims:** If the warranty and the remedy for any failure of any product to comply with any warranty are deemed for any reason to fail their intended purpose, Seller's liability for any failure of any product to comply with any such warranty, together with any and all other liability, if any, arising out of or in connection with such product, including, but not limited to, all claims, whether in Contract, tort, or otherwise, arising out of, connected with, or resulting for the manufacture, sale, delivery, resale, repair, replacement, or use of the product, shall not exceed the purchase price for such product. In no event shall Seller be responsible or liable to Buyer or any third party under any circumstances for any indirect, consequential, special, punitive or exemplary, damages or losses, including, but not limited to, damages for loss of profits, goodwill, use of the product or any other equipment or other intangible losses which may be incurred in connection with the product regardless of the type of claim or the nature of the cause of action, even if Seller has been advised of the possibility of such damage or loss. Any and all claims that Buyer has against Seller, whether or not Buyer is aware of such claims, must be brought by Buyer within the applicable thirty (30) days after the date that such claim first arose, but in any event within the applicable warranty period set forth above. Any claim not brought by Buyer within the applicable thirty (30) day period shall be deemed null and void.

5. **IMDEMNIFICATION:** Buyer will indemnify and hold harmless Seller, its affiliates and their respective officers, directors, employees, agents and other representatives and defend any action brought against same with respect to any claims, judgments, actions, suites, demands, damages, liabilities, costs or expenses (including, but not limited to, reasonable attorneys' fees and legal expenses) associated with or arising from the ownership, use or operation of the products by Buyer or any third party, including without limitation, product liability, an international, federal or state occupational safety and health statute, or any other governmental regulations or laws, and also with respect to any fault or negligence of the seller. If buyer fails to fulfill any of its obligations under this paragraph or any other part of this agreement, buyer agrees to pay seller's costs, expenses, and attorney fees incurred by seller to enforce or establish its rights under this paragraph or any other part of this agreement.

6. **TERMINATION OF PERFORMANCE:** Buyer may cancel its order only with the written consent of Seller and upon terms that will indemnify Seller for any loss, damage and expense arising from such cancellation. Seller may terminate this Contract pursuant to Sections 2 and/or 11 hereof, and in such event, Seller shall have no further reliability to produce or ship any products hereunder and shall have no liability for damages to Buyer or any third party.

7. **TECHNICAL ADVICE:** No obligation or liability shall arise out of Seller's rendering of technical advice in the connection with Buyers' order or products. Any technical advice furnished, or recommendation made by Seller or any employee or representative of Seller, concerning any use or application of any products or parts furnished under this Contract is believed to be reliable, but Seller makes no warranty, express or implied of results to be obtained. Buyer assumes all reasonability for loss or damage resulting form the handling or use of any such products or part is accordance with such technical advice or recommendation. The selection of the products ordered, or design of any customer products, shall be Buyer's sole and ultimate responsibility, and Seller shall have no liability whatsoever for any design defects of custom products, or if the products ordered are unsuitable for Buyer's intended use. Any advice or assistance provided by Seller to Buyer in connection with Buyer's selection or design of the products is at Buyer's risk, and Seller makes no representation or warranty whatsoever in connection with such advice or assistance.

8. **ASSIGNMENT:** Buyer shall not assign its rights or obligations under this Contract without the prior written consent of Seller, which consent may be withheld for any reason in the sole discretion of Seller. Any attempt at such assignment by Buyer without the prior written consent of Seller shall be deemed null and void. This Contract will be binding upon the parties hereto, and the successors and permitted assigns.

9. **SECURITY INTEREST OF SELLER:** Title to the products will not pass to Buyer until all required payments have been made to Seller. Until the purchase price and all other applicable costs and expenses are paid in full, Seller reserves a purchase money security interest in the products and the proceeds therefrom, and Seller thereby possesses the rights of a secured party under the Uniform Commercial Code. Upon Seller's request, Buyer shall execute all necessary financing statements and other documents evidencing this security interest with the appropriate sate and local authorities. Seller is entitled to and is hereby granted reasonable access to Buyer's locations as necessary to exercise its remedies as a secured party.

10. **GOVERNING LAW:** This Contract shall be construed, interpreted, and governed by the laws of the State of South Dakota without regard to its conflict of laws principles. The exclusive forum for any disputes arising out of or relating to this Contract shall be any federal or state court sitting in the State of South Dakota. The parties irrevocably consent to such exclusive jurisdiction in such courts and to the proper venue therein.

11. **FORCE MAJEURE:** Seller does not assume the risk of and shall not be liable for failure to perform any obligation relating to the products caused by civil insurrection, war, fire, strike, labor disturbances, acts of God, acts or omissions of Buyer, acts or omissions of the United States Government, floods, epidemics, freight embargoes, shortages of fuel, energy or materials, failure of suppliers or subcontractors to satisfactorily meet scheduled deliveries, or any other cause beyond the reasonable commercial control of Seller

12. **NOTICES:** Any notices, consents or other communications required or permitted under this Contract must be in writing and delivered personally, overnight air courier, registered or certified mail or facsimile. Unless otherwise stated in this Contract, notices, consents or other communication will be deemed received (a) on the date delivered, if delivered personally or by facsimile transmission; (b) on the next business day if sent via overnight air courier; or (c) three (3) business days after being sent, if sent by registered or certified mail.

13. **SEVERABILITY; WAIVER:** The invalidity or unenforceability of any provision of this Contract shall not affect the validity or enforceability of any other provision of this Contract. No waiver of any of the provisions of this Contract shall be deemed, or shall constitute a waiver of any other provision, whether or not similar, nor shall any waiver constitute a continuing waiver. No waiver shall be binding unless executed in writing by the party making the waiver. The Section headings included herein are for the convenience of the parties only and no way alter, modify, amend, limit or restrict the contractual obligations of the parties.

14. **NO THIRD PARTY BENEFICIARIES; SETOFF:** Nothing in this Contract is intended to, or shall, create any third-party beneficiaries, whether intended or incidental and neither party shall make any representations to the contrary. Seller shall have the right to deduct from any sums it owes to Buyer, and sums or the value of any obligation owed by Buyer to Seller.

15. **ENTIRE AGREEMENT:** The terms set forth herein constitute the sole terms and conditions of the Contract between Buyer and Seller. Notwithstanding the foregoing or any other term of this Contract, to the extent this Contract conflicts with the terms or conditions of any written distributor agreement between the parties, the written distributor agreement shall control. No other warranty, term, condition or understanding, whether oral or written shall be binding upon Seller, unless hereafter expressed in writing, approved and signed by Seller.

16. **SURVIVAL**: The provisions of Sections 3, 4, 5, and 7 through 16 shall survive the termination and performance of this Contract.

SAFETY RULES

READ CAREFULLY BEFORE OPERATING EQUIPMENT

WHEEL LUGS MUST BE CHECKED AND RE-TORQUED AFTER FIRST 30 MILES

IMPORTANT

Wheel lugs must be properly torqued before using your conveyor in radial travel mode.

Safety must be a primary consideration when operating any type of machinery. Accidents are the result of carelessness or negligence on the part of the operator. The following safety considerations are not meant to cover every possible condition or situation that may occur. Common sense and precaution must be practiced at all times when installing, operating and maintaining any MASABA machinery.

IMPORTANT

It is the responsibility of the owner to establish and maintain a safety training program that covers equipment operation and maintenance in accordance with all MSHA, OSHA, and local, state, and federal guidelines. All personnel operating this equipment MUST read and understand this Owner's Manual and all warnings and safety precautions. Be aware of all posted warning, caution, or danger decals on your equipment. Compliance with these warnings is mandatory to prevent serious injury or death.

IMPORTANT

Guards and safety devices have been factory installed. Any additional guards or safety devices required to meet local, state or federal guidelines are the responsibility of the end user.

- **ALWAYS RESPECT HEAVY MACHINERY FOR WHAT IT IS.**
- **ONLY QUALIFIED PERSONNEL MAY OPERATE OR MAINTAIN EQUIPMENT. ALL PERSONNEL OPERATING THIS EQUIPMENT MUST READ AND UNDERSTAND THIS OWNER'S MANUAL AND ALL WARNINGS AND SAFETY PRECAUTIONS.**
- **NEVER OPERATE ANY MACHINERY WITHOUT ALL GUARDS AND HOUSINGS PROPERLY INSTALLED AND IN GOOD WORKING CONDITION. NEVER OPERATE ANY EQUIPMENT WHILE UNDER THE INFLUENCE OF DRUGS OR ALCOHOL.**
- **NEVER LEAVE THE MACHINE RUNNING AND UNATTENDED.**
- **NEVER ATTEMPT TO ADJUST, LUBRICATE, REPAIR, MAINTAIN, ETC. ANY MACHINERY WHILE IT IS MOVING OR OPERATING. ALWAYS USE "LOCK-**

OUT/TAGOUT" PROCEDURES ESTABLISHED BY YOUR COMPANY BEFORE WORKING ON ANY EQUIPMENT.

- **NEVER ATTEMPT TO RIDE ON A MOVING PIECE OF MACHINERY.**
- **DO NOT WALK ON MACHINERY GUARDS, GRATINGS, OR COVERS.**
- **DO NOT PLACE HANDS, FEET OR ANY PART OF THE BODY NEAR MOVING PARTS.**
- **NEVER WEAR LOOSE CLOTHING, NECKTIES, OR JEWELRY AROUND MOVING PARTS. LONG HAIR SHOULD BE SECURED UNDER A CAP OR HAT.**
- **ALWAYS WEAR EYE PROTECTION, HEARING PROTECTION, RESPIRATORS, GLOVES, HARD HATS, SAFETY SHOES AND OTHER PROTECTIVE CLOTHING WHEN REQUIRED. MATERIAL CAN AND WILL FALL OFF AT ANY POINT AND CAN CAUSE SERIOUS INJURY.**
- **KEEP ALL OPERATING PERSONNEL ADVISED OF THE LOCATION AND OPERATION OF ALL EMERGENCY STOPS AND CONTROLS. CLEAR ACCESS MUST BE PROVIDED TO THESE STOPS AND CONTROLS MUST BE MAINTAINED AT ALL TIMES.**
- **FREQUENT INSPECTIONS OF ALL EMERGENCY STOPS, CONTROLS, GUARDS, GRATINGS OR COVERS MUST BE MAINTAINED AT ALL TIMES.**
- **ALWAYS FOLLOW "LOCKOUT/TAGOUT" PROCEDURES ETABLISHED BY YOUR COMPANY WHEN PERFORMING ANY TYPE OF MAINTENANCE OR REPAIR.**
- **BEFORE STARTING ANY EQUIPMENT, MAKE SURE THAT THE OPERATOR HAS READ AND UNDERSTANDS ALL OPERATION AND SAFTEY GUIDELINES. VERIFY THAT THE AREA AND EQUIPMENT ARE SAFE FOR OPERATION AND ALL GUARDS ARE IN PLACE AND SECURE. OPERATORS <u>MUST</u> PERFORM A PRE-OPERATION SAFETY INSPECTION.**
- **NEVER ALTER, MODIFY OR ATTEMPT TO USE THE CONVEYOR FOR ANYTHING OTHER THAN ITS INTENDED USE.**
- **NEVER ATTEMPT TO MOVE OR RELOCATE A CONVEYOR WITH THE SLIP TUBE EXTENDED (CONVEYOR RAISED). THE SLIP TUBE MUST BE FULLY RETRACTED AND SECURED BEFORE MOVING A CONVEYOR.**

HYDRAULIC SYSTEMS SAFETY (IF EQUIPPED)

- **CHECK ALL HOSES FOR SIGNS OF WEAKNESS OR CRACKS BEFORE USING EQUIPMENT.**
- **CHECK FLOW DIAGRAM TO BE CERTAIN THE SYSTEM IS DEPRESSURIZED BEFORE ATTEMPTING REPAIRS. SEE APPENDIX O FOR THE HYDRAULIC SCHEMATIC.**
- **BE AWARE OF HEAT BUILDUP IN SYSTEM AND ALLOW COOLING BEFORE BEGINNING REPAIR OR MAINTENANCE.**
- **SQUEEZE OR FLEX FLEXIBLE HOSES TO CHECK FOR PRESSURE BEFORE LOOSENING FITTINGS.**
- **USE "WHIP-CHECKS" TO MOUNT AND SECURE HYDRAULIC LINES TO PREVENT INJURIES FROM WHIPPING OR FLAILING HOSES.**

GENERAL

Successful operation of a machine depends upon good maintenance. Machinery must be inspected regularly to make sure that all moving parts are in good operating condition and that all bolts are tight. During the first week of operation, check the bolts for tightness daily and then periodically thereafter. This procedure also applies to parts and components that have been disassembled and reassembled during normal maintenance periods.

Caution must be used when operating your equipment in high winds. If possible lower your conveyor to its lowest setting during periods of high wind. If lowering you conveyor is not possible, secure it to the ground at the axle. High winds can blow your conveyor over causing serious injury and equipment damage.

Statements used throughout this user manual to draw attention to important safety measures include but are not limited to the following:

IMPORTANT

IMPORTANT is used to identify a procedure that needs to be followed to prevent machine damage or personal injury.

⚠ CAUTION

The instructions that follow this level of warning draw attention to a safe operating procedure. If the instructions are ignored the possibility of personal injury may exist.

⚠ WARNING

The instructions that follow this level of warning draw attention to the possibility of a serious hazard. Failure to follow these instructions may put an individual at risk of serious injury or death.

⚠ DANGER

The instructions that follow this level of warning are the most serious. Failure to follow these instructions will most likely result in serious injury or death.

SAFETY DECALS

The decals shown below are a representation of the types of decals you may find on your equipment. It is the responsibility of the operator to replace any worn, torn, hard to read or missing decals.

WARNING
Equipment starts automatically - can cause severe injury
KEEP AWAY
WARNING
Exposed moving parts can cause severe injury
LOCK OUT POWER before removing guard
DANGER
Climbing, sitting, walking or riding on conveyor at any time will cause severe injury or death
KEEP OFF
WARNING
Moving equipment can cause severe injury
KEEP AWAY
DANGER
Moving parts will cause severe injury
KEEP AWAY
WARNING
Walking or standing on conveyor covers or gratings can cause severe injury
STAY OFF

SETTING UP YOUR GRIZZLY FEEDER PLANT

SITE PREPARATION

- Location of the Feeder Plant is generally determined by the location of discharge of material to be conveyed. Improper site conditions can adversely affect the operation and maintenance of your Feeder Plant.

- The area around the Feeder Plant should be kept clear and level to make the loading of discharge material as convenient as possible.

- The Feeder Plant must have adequate clearance all around to allow for maintenance and the removal of material spillage.

- The discharge conveyor work site must have solid compacted ground with no more than one degree slope to ensure proper operation. This will prevent the Feeder Plant from rolling down hill.

UNLOADING YOUR MASABA EQUIPMENT

It is recommended that you unload your Feeder Plant at the site it will be used.

Your Feeder Plant was delivered fully assembled and can be disconnected from the delivery truck at the designated site.

To disconnect your Feeder Plant from the delivery truck:

1. Set the air brakes or block the wheels on the Feeder Plant.

2. Your Feeder Plant is equipped with manual landing legs. Lower the landing legs until the Feeder Plant king pin is high enough to take pressure off the delivery truck.

⚠WARNING

Landing legs can crush hands and feet. Make sure the area beneath the landing leg is clear before operating the manual crank to lower the landing legs. Failure to do so can result in serious injury.

3. Disconnect the air brakes from the tractor.

4. Disconnect the king pin from the tractor.

5. Drive tractor away from the Feeder Plant.

OPERATING YOUR GRIZZLY FEEDER PLANT

POWER CONNECTION

⚠ DANGER

PROPER "LOCKOUT/TAGOUT" PROCEDURES SHOULD BE FOLLOWED BEFORE ATTEMPTING TO CONNECT YOUR GRIZZLY FEEDER PLANT TO ANY POWER SOURCE. FAILURE TO FOLLOW YOUR COMPANY DESIGNED "LOCKOUT/ TAGOUT" PROCEDURE CAN RESULT IN SERIOUS INJURY OR DEATH.

Before operating your Feeder Plant you will need to connect it to an external power supply. Be sure your power supply has the proper voltage. Improper voltage and/or power surges can damage the electronic systems and **will void warranty**.

IMPORTANT

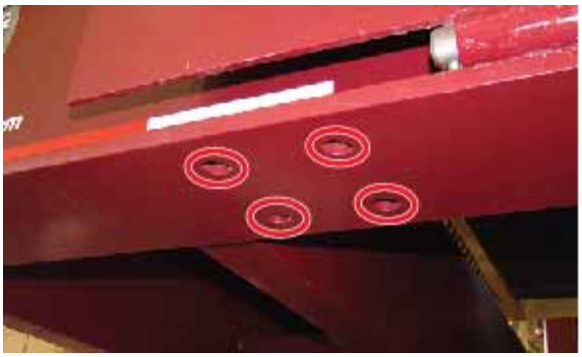
It is important to inspect the power supply cord for cuts or other damage. Use of a damaged cord can result in equipment damage and/or personal injury.

CRIBBING YOUR GRIZZLY FEEDER PLANT

Use the following procedures to properly crib your Grizzly Feeder Plant. These procedures may vary depending on the style of Grizzly Feeder Plant you purchased.

1. If you purchased your Feeder Plant equipped with a discharge conveyor, it arrived with the front cribbing legs in travel position. They must be unbolted from the Feeder Plant chassis before use.

2. Locate the four (4) holes near the front of the Feeder Plant chassis on each side.



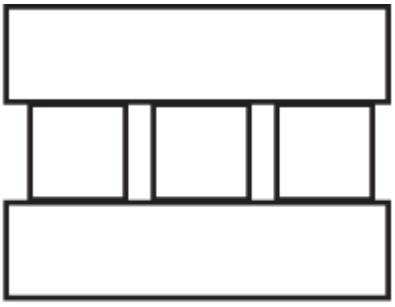
3. Bolt the cribbing legs to the chassis on both sides of the Feeder Plant using the supplied hardware.

4. Lift the Feeder Plant with either the landing legs or by chain/cable attached to the front lifting eyes so the plant can be leveled.

⚠ CAUTION

Be sure to inspect all lifting equipment for extreme wear or damage and maintain according to manufacturer's guidelines.

5. Cross crib all cribbing points on both sides of the Feeder Plant.



Cross Cribbing Example

6. Once the Feeder Plant is properly cribbed and level, retract the Feeder Plant landing legs.

7. Attach a chain/cable to the two attachment points on the folding Feeder Plant skirts.

8. Remove the two bolts that secure the skirt to the Feeder Plant and slowly lower the skirt into position.

IMPORTANT

Never attempt to lower the Feeder Plant skirt by hand. Always use a chain/cable for this procedure.

⚠WARNING

Make sure all personnel are clear of the unfolding skirt. Pinch points exist along the entire length of the hinged area. Failure to do so can result in serious injury.

IDENTIFYING YOUR GRIZZLY FEEDER PLANT

Your Grizzly Feeder Plant is equipped with an electrical panel and a hydraulic system for controlling material discharge functions. Depending on the Feeder Plant you purchased, the electrical panel consists of either six (6) or eight (8) buttons that control designated functions, one (1) hydraulic manual over-ride switch, and the emergency stop button.

The function buttons are identified as follows:

- **DISCHARGE START:** Press this button to start the discharge conveyor.

IMPORTANT

It is important to start the discharge conveyor prior to starting the feeder conveyor. Failure to do this may result in material spillage or equipment damage.

- **DISCHARGE STOP:** Press this button to stop the discharge conveyor.

IMPORTANT

It is important to stop the feeder conveyor prior to stoping the discharge conveyor. Failure to do this may result in material spillage or equipment damage.

- **FEEDER START:** Press this button to start the feeder conveyor.

- **FEEDER STOP:** Press this button to stop the feeder conveyor.

- **FEEDER + SPEED:** Push this button to increase the belt speed of the feeder conveyor.

- **FEEDER - SPEED:** Push this button to decrease the belt speed of the feeder conveyor.

- **HYDRAULIC MANUAL OVER-RIDE:** Turn this switch clockwise from “off” to “on” to allow for the use of the manual hydraulic levers.

- **HYDRAULIC UNIT START:** Press this button to start the hydraulic unit to allow for the use of the manual hydraulic levers.

- **HYDRAULIC UNIT STOP:** Press this button to stop the hydraulic unit.

- **EMERGENCY STOP:** Pull this button to start and Push it to stop all functions in case of emergency.

OPERATING YOU GRIZZLY FEEDER PLANT

CONVEYOR PREPARATION

Prior to running your conveyor for the first time perform the following tasks:

- Confirm that all shipping brackets and straps have been removed and that there are no obstructions to impede the operation of the conveyor belt.
- Always track belts prior to running material, belts may need to be adjusted once material starts running. See Appendix C for belt tracking instructions.
- Minimize side load/feed of belt in hopper area to minimize tracking issues.
- Make sure material is being fed on the center of the belt as much as possible.
- Check all conveyor flashing to make sure it is in the proper position and fully tightened to reduce spillage.
- Check “V-Belts” on belt drive for proper tensioning.

CONVEYOR OPERATION

To start using your Grizzly Feeder Plant using the electric control panel, perform the following steps:

1. Pull the “Emergency Stop” button to the start position.

2. Push the “Discharge Start” button to engage the discharge conveyor.

3. Push the “Feeder Start” button to engage the feeder conveyor.

ADJUSTING DISCHARGE CONVEYOR HEIGHT (IF EQUIPPED)

If you purchased a Grizzly Feeder Plant that has an adjustable height discharge conveyor, use the following steps to adjust the conveyor height.

1. Turn the “Hydraulic Manual Over-Ride” switch to the “ON” position.

2. Push the “Hydraulic Unit Start” button to activate the hydraulic unit.

3. Locate the hydraulic handle labeled “CONV HEAD” and operate it in the direction of the “U”. As the slip tube raises (or lowers), watch for adjustment holes in the undercarriage. Stop the slip tube when the holes appear at the desired discharge height.

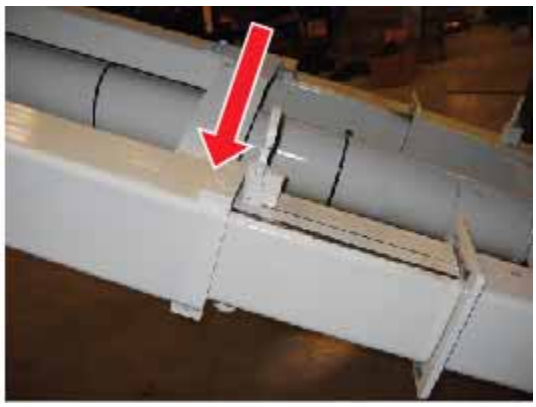
4. Insert the supplied retention pins into the undercarriage holes to secure the slip tube.

⚠WARNING

Failure to insert slip tube retention pins properly can result in conveyor damage and possible injury.

IMPORTANT:

When inserting the slip tube retention pins, it is important that the tab on the pin faces away from the raised slip tube as indicated below. Do not use the pin tab to get more height, tube damage may result.



GRIZZLY OPERATION

Your Grizzly Feeder Plant is equipped with two (2) hydraulic cylinders that are used to tilt the Grizzly to remove oversized material. These functions can also be performed through the use of an **OPTIONAL** remote control unit. See the remote control unit User's Manual for more details on its operation.

⚠ DANGER

THE AREA AROUND THE TILTING GRIZZLY HOPPER MUST BE KEPT CLEAR OF PERSONNEL DURING THE OPERATION OF THE HYDRAULIC CONTROLS OR REMOTE CONTROLS (IF EQUIPPED). FAILURE TO DO SO CAN RESULT IN SERIOUS INJURY OR DEATH. IT IS IMPORTANT THAT ANYONE OPERATING THE OPTIONAL REMOTE CONTROL HAVE LINE OF SIGHT VISION TO THE AREA AROUND THE TILTING GRIZZLY HOPPER.

Use the following procedures to tilt the Grizzly.

1. If the hydraulic unit is not on, locate the "Hydraulic Manual Over-Ride" switch and turn it to the "ON" position.

2. Push the "Hydraulic Unit Start Button" to activate the hydraulic unit.

3. Locate the hydraulic lever labeled "GRIZZLY" and operate it in the direction of the "U". After oversized material has been removed, return the Grizzly to it's starting position by operating the hydraulic lever in the "D" direction.

The Grizzly has the ability to operate at a variety of angles to allow oversized material to be removed during normal operation. Use the following procedures to set the desired operating angle of the Grizzly.

1. With the hydraulic unit running, operate the hydraulic lever labeled “GRIZZLY” in the direction of the “U” until the desired operating angle is achieved. Insert the stop pins in the slip tubes at both ends at the desired angle..

2. Operate the “GRIZZLY” lever in the direction of the “D” until the Grizzly comes to rest.

3. Resume normal operation.

MAINTENANCE

BELT TRACKING

Prior to running the conveyor loaded with material, the belt tracking should be checked. Belt training is the process of adjusting idlers to insure that the belt travels over the center of the idlers, return rollers, and pulleys.

DO NOT ATTEMPT TO TRAIN THE BELT BY ADJUSTING THE SCREW TAKE-UPS. The take-ups are used for belt tension, and to keep the tail pulley square with the frame.

A normal sequence of training is to start with the return run working toward the tail pulley and then follow with the top run in the direction of belt travel. The primary rule which must be kept in mind when tracking a conveyor belt is simply: "THE BELT MOVES TOWARD THAT END OF THE ROLL/IDLER IT CONTACTS FIRST".

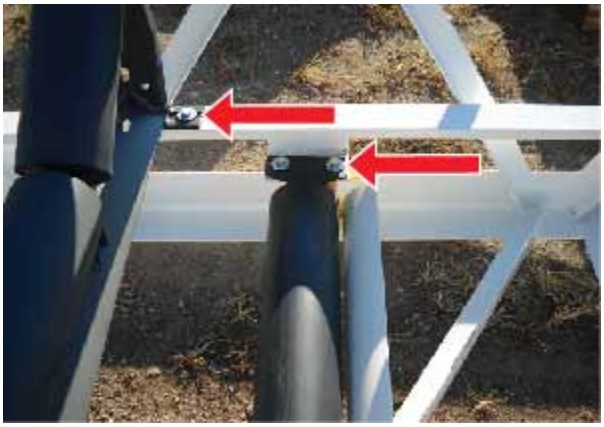
The following steps should be taken to properly train the belt to run over the center of the pulleys, troughing idlers, and return rollers:

- Ensure that all frames are level. If the frames are not level, the belt will be forced to one side or the other.

- Square the tail pulley by measuring from a fixed point on both sides of the conveyor.

- Check the belt splice for squareness. The belt ends should be squared from a center line at least 15 feet long and accurately derived from center point measurements along the belt. Do not use the edge of the belt for reference.

- Square all troughing and return rollers with the frame and tighten the attachment bolts.



- Run the conveyor empty and at reduced speed if possible. Look for a side creep at any point along the frame. Check the return travel for side creep. Make adjustments where side creep occurs as follows:

⚠WARNING

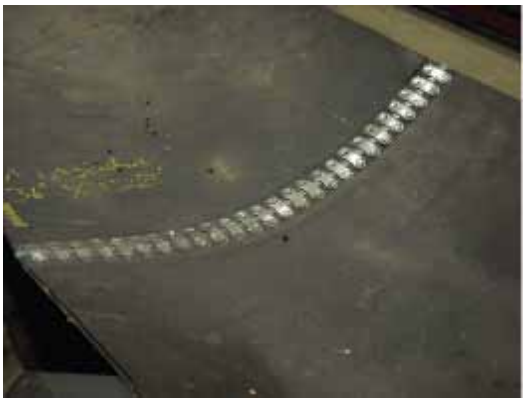
The conveyor must be powered <u>off</u> before attempting to adjust any return rollers or idlers. Failure to do so can result in serious injury.

1. The point of maximum side creep requires adjustment of a preceding roller when you are facing in the direction toward which the belt is moving.

2. Loosen the bolts and pivot the roller around its midpoint, making these adjustments in small increments. Tighten the bolts and make a test run after each adjustment to see the effect on side creep. If the point of maximum side creep changes, adjust the roller that precedes that new point.

3. When the slow running belt is centered, change to normal speed. Load the belt with material and continue testing until belt is running centered.

4. If the belt should show a side creep only at the splice point as it runs along the conveyor, rather than at one point, the splice is not square and should be re-done. See appendix B for detailed instructions on proper belt splicing.



TROUBLESHOOTING BELT CONVEYORS

1. ALL PORTIONS OF CONVEYOR BELT RUNNING TO ONE SIDE AT A GIVEN POINT ON STRUCTURE.

PROBLEM	CORRECTION
One or more idlers immediately preceding trouble point not at right angles to direction of belt travel.	Advance, in the direction of belt travel, the end of the idler toward which the belt has shifted.
One or more idler stands not centered under belt.	Center them.
Belt runs off terminal pulley.	Check terminal pulley alignment. Check alignment of idlers approaching terminal pulley.
Buildup of material on idlers.	Improve maintenance. Install brushes or other cleaning device.
Structure not level and belt tends to shift to low side.	Level Structure.

2. PARTICULAR SECTION OF BELT RUNS TO ONE SIDE AT ALL POINTS OF CONVEYOR.

PROBLEM	CORRECTION
Belt not joined squarely.	Square ends & re-splice.
Cambered belt.	Tension it or replace it.

3. CONVEYOR BELT RUNS TO ONE SIDE FOR LONG DISTANCE ALONG BED.

PROBLEM	CORRECTION
Load being placed on belt off-center.	Adjust chute and loading conditions so as to place in center.
Conveyor frame or structure crooked.	Straighten it.

4. SEVERE WEAR ON PULLEY SIDE OF CONVEYOR BELT.

PROBLEM	CORRECTION
Slippage on drive pulley.	Increase tension if belt construction permits. Lag drive pulley (groove if wet)
Spillage of material between belt and pulley, or material builds up at loading point until belt is dragging.	Improve loading conditions with chutes. If belt loaded too full, increase belt speed or decrease feed. Install plows or scrapers in front of tail pulley on return run.
Excessive tilt to troughing idlers.	Adjust to not more than 2 degrees from line perpendicular to belt.
Sticking idlers.	Improve maintenance and lubrication.

5. PRODUCT SLIPS ON INCLINE.

PROBLEM	CORRECTION
Belt dirty.	Clean it.
Incline too steep.	Decrease incline.

6. COVER BLISTERS OR SAND BLISTERS.

PROBLEM	CORRECTION
Cover cuts or very small cover punctures allow fine particles of sand to work under the cover and cut cover away from underneath blister area.	Make spot repair with vulcanizer or repair dough, after removing and cleaning the carcass.
Oil either in material or from outside source.	Remove source of oil, if possible. Check lubrication.

VENDOR SPECIFIC MAINTENANCE SCHEDULES

For maintenance schedules that are specific to the parts installed on your MASABA Equipment, please refer to the corresponding appendix.

INSTALLING/TENSIONING V-DRIVES

CHECK CONDITION OF SHEAVES

Before installing a new set of V-Belts, examine the sheaves. Dirty or rusty sheaves impair the drive's efficiency and abrade the belts, which results in pre-mature failure. Worn sheaves shorten V-Belt life by as much as 50%. If the grooves are worn to where the belt bottoms, slippage may result and burn the belts. If the sidewalls are "dished out", the bottom shoulder ruins the V-Belts pre-maturely by wearing off the bottom corners.

⚠WARNING

The conveyor must be powered <u>off</u> before removing safety guards and must remain off while performing any maintenance function. Failure to do so can result in serious injury.

CHECK SHEAVE ALIGNMENT

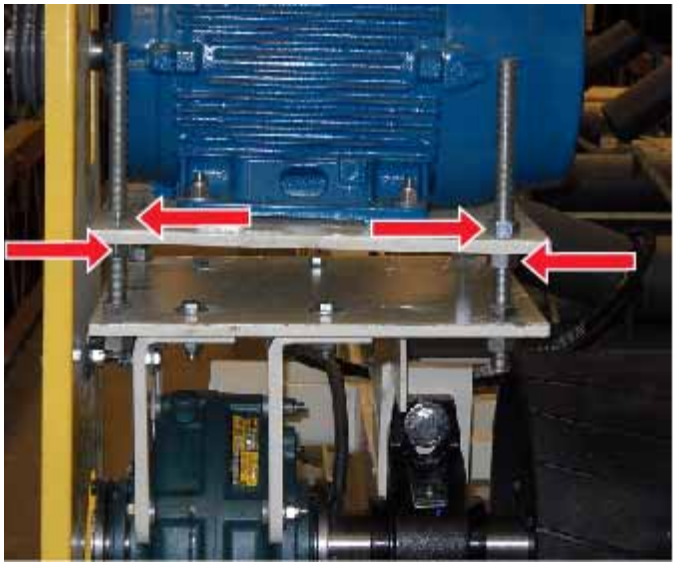
Sheave adjustment should be checked by placing a straight edge across the sheave face so that it touches all four points of contact.

Improper sheave alignment produces:

- Uneven wear on one side of the V-Belt
- The V-Belt to roll over in the sheaves
- Puts the entire load on one side of the V-Belt, stretching or breaking the cords on that side.

V-BELT INSTALLATION

Shorten the center distance of the drive until the V-Belts can be put on the sheaves without stretching. Stretching the V-Belts can cause internal damage to the belts. Center distance can be decreased by adjusting the motor height as shown below.



BELT SELECTION

For maximum service, replace V-Belt drives with a complete new matched set of belts. Never employ a used V-Belt as a replacement for one of a set of new V-Belts. Used belts normally are worn in cross-section and stretched, and will cause the new belts to accept its load. A new belt used with old belts will ride higher in the sheave, travel faster and operate at a much higher tension than the used belts. The cord center may be ruptured, allowing the new belt to elongate. Shortly after this occurs it will cease to accept its full share of the load, leaving the drive underbelted. Belts of different manufactures should not be mixed for the same reasons.

GENERAL RULES OF TENSIONING

- IDEAL TENSION IS THE LOWEST TENSION AT WHICH THE BELT WILL NOT SLIP UNDER PEAK LOAD CONDITIONS.

- CHECK TENSION FREQUENTLY DURING THE FIRST 24-48 HRS OF RUN-IN OPERATION.

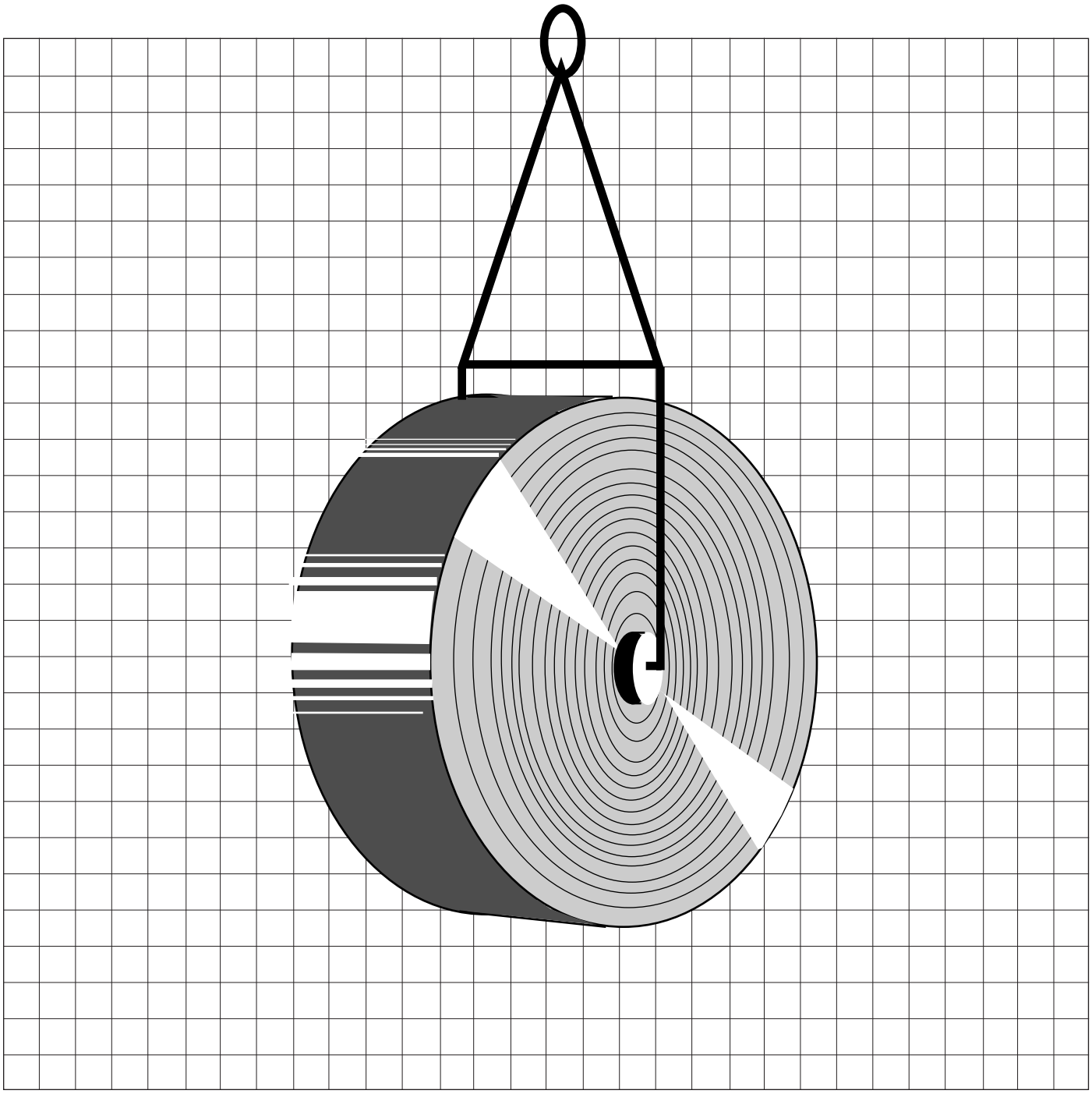
- OVER TENSIONING SHORTENS BELT AND BEARING LIFE.

- TENSION BELTS WHEN SLIPPING. **NEVER APPLY BELT DRESSING** AS THIS WILL DAMAGE THE BELT AND CAUSE EARLY FAILURE.

APPENDIX A

FENNER DUNLOP
CONVEYOR BELTING

Conveyor Belt Storage and Installation



Conveyor Belt Storage and Installation

Receiving the Roll

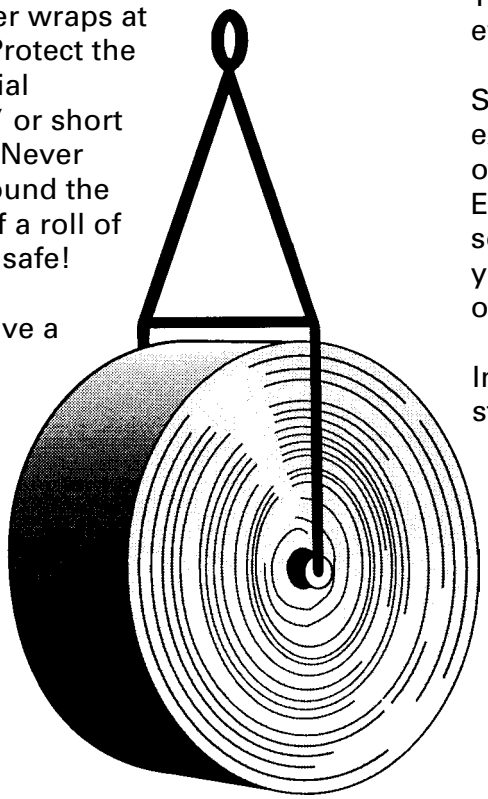
Upon delivery, check the factory packaging for damage, punctures, etc. Make any appropriate claim against the carrier at that time.

Handling the Roll

Factory packaging is designed to protect your conveyor belt during normal shipping and handling. When a belt arrives, be careful unloading it. Don't drop it or handle it roughly. This could break the packaging and cause the belt to telescope. Once a belt telescopes, it is almost impossible to re-roll.

Try not to roll it, but if you must, roll in the direction the belt is wound. Rolling a belt in the opposite direction can cause it to loosen and telescope.

The best way to move a belt is to slip a sturdy hoisting bar through the center core. Then, lift it with a sling or with strong cables. Be careful that these hoist cables don't damage the outer wraps at the belt edges. Protect the edges with special "spreader bars," or short wooden planks. Never apply a sling around the circumference of a roll of belting. . .it isn't safe!



You can also move a belt safely by laying the roll flat on a skid and hoisting the skid with a forklift. Just be sure the forks on the lift don't come in contact with the belt itself.

Storage

When storing a new conveyor belt, leave it hoisted or stand it upright, preferably on a dry surface (do not lay the roll on its side). A wooden skid is best. Block it safely so it can't accidentally roll.

Extreme temperature variations can have an adverse affect on a belt over long periods of time. The ideal storage range is between 50°F and 70°F.

Long exposure at temperatures even slightly below 40°F can harden or stiffen the compounds. If installed on a conveyor in this stiffened state, the belt may not train well until it adjusts or "warms up" to the system. Neoprene, for example, is especially sensitive to low temperatures and should never be stored at less than 40°F. Stiffened neoprene belting is different than other constructions. It won't loosen up until it's had a lengthy exposure to relatively mild temperatures.

Temperatures over 90°F have an adverse effect, too, and should be avoided.

Sunlight and ozone can also deteriorate any exposed rubber over time. Store your belt out of the direct sunlight whenever possible. Electrical generators or arc welders can sometimes generate ozone. It is best to store your belt some distance away from this type of equipment.

In general, it's wise to keep any unused belt stored in its protective factory packaging until it's ready for installation.

Used belt should be thoroughly cleaned and dried prior to storage.

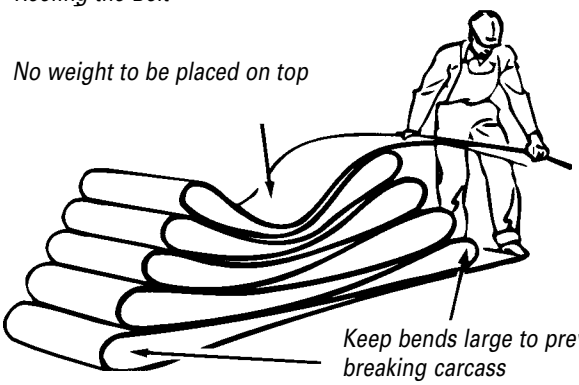
A dry place out of direct sunlight is preferred for storage, excessive temperature variations or extremes being avoided. Belts should not be stored in excessively wet places or in areas where oils, gasoline, paint

materials, acids and chemicals are also stored or used. Motor-control rooms, welding shops, and other places where ozone is generated should likewise be avoided. A belt should not be permitted to rest on a concrete floor. If it is necessary to lay a belt on the floor, use a pallet or a cradle.

Belts which are not endless should be stored in rolls. Once thoroughly cleaned and dried, it is good practice to dust a belt with tire talc or to insert kraft paper between the layers when rolling it up. Care should be taken not to roll a belt too tightly. Be sure the interior diameter of the roll is sufficiently large to avoid any possible carcass damage or warping. The belt should be rolled evenly to avoid telescoping and warping. Excessive flexing or sharp bends of any sort are to be avoided. Rolls should not be stood on edge or leaned against a wall.

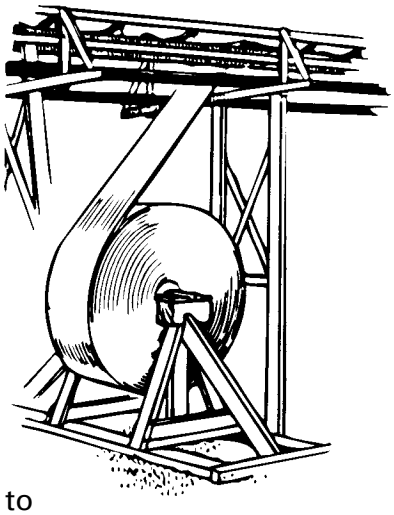
Small endless belts may be hung up on a dowel or a peg for storage. It is advisable to rotate the belt occasionally to avoid a constant flex or bend at one point. Larger endless belts may be stored flat, doubling them over as necessary. It is advisable when doubling a belt over to be sure that the edges of the belt are in line to avoid any warping. As above, it is good practice to rotate and repile the belt occasionally to avoid constant flexing or bending at any point. Bends should be made as large as possible to avoid cracking the carcass.

Reefing the Belt



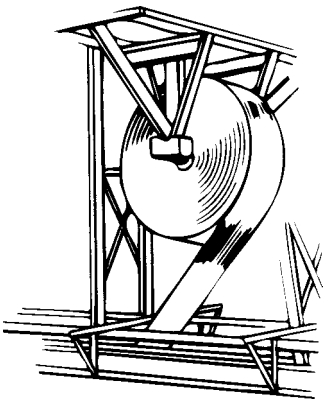
Installation

Once the roll of belting has been transported to the point of installation it should be mounted on a suitable shaft for unrolling and threading onto the conveyor. Conveyor belting is normally rolled at the factory with the carrying side out. Consequently, in mounting the roll, the belt must lead off the top of the roll if it is being pulled onto the troughing or carrying idlers but off the bottom of the roll if it is being pulled onto the return idlers. The illustrations below represent suitable methods of mounting and stringing belt for each case.



Left: Temporary flat roll at bend point

Below: Threading through return strand



Note: Temporary flat roll at bend point, as roll is pulled onto troughing idlers

In some cases, such as in the mines where head room does not permit maneuvering a roll, the belt may have to be pulled off the roll and reefed (Left). Extreme care should be exercised to see that the loops have large bends to avoid kinking or placing undue strain on the belt. No weight should ever be placed on the belt when it is in this position. Another method of handling belting under such conditions is to lay the roll on a turntable with a vertical spindle.

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FENNER DUNLOP

CONVEYOR BELTING AMERICAS

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ISO 9001:2000 Certified

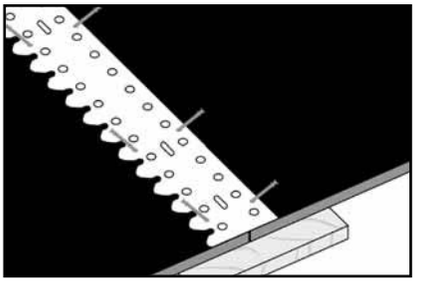
10/03

APPENDIX B

Installing Flexco® Bolt Solid Plate

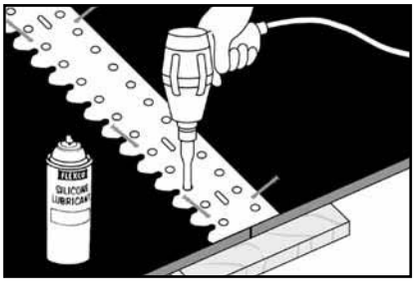
Instructions for Installation

1. Square belt ends using centerline method. Cut belt ends using Flexco 840 Series Belt Cutter.

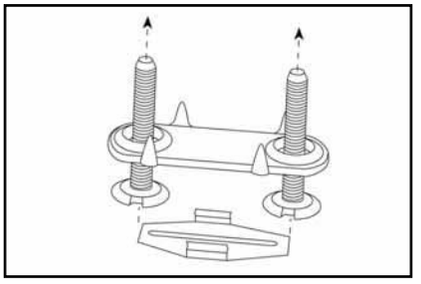


2. Support belt ends with wood plank. Nail Flexco Templet in position with belt ends tight against lugs.

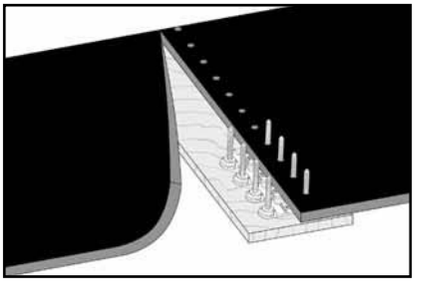
3. Spray templet holes with Flexco Silicone Lubricant. Punch or bore bolt holes. Remove templet.



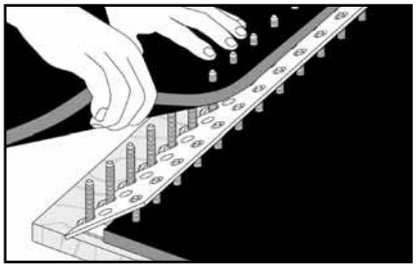
NOTE: A ½" square drive electric impact wrench with Flexco 5552 Quick Change Chuck will speed hole boring operation.



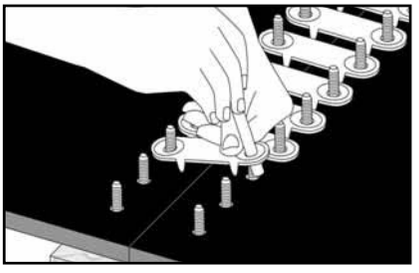
4. For 2-1/2, 3, 1-1/2FP, 2FP, RP1, and RP2, assemble bottom plate. Insert 2 bolts and attach clip.



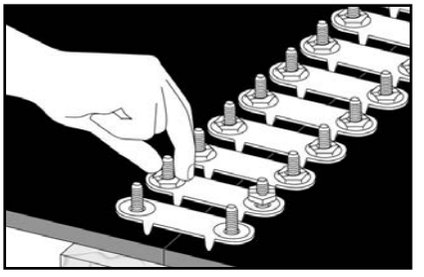
5. Fold one belt end back and insert bolts in one row of holes.



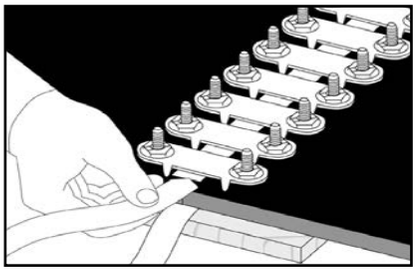
6. Align bolts with templet teeth and place the other belt end over bolts. Remove templet.



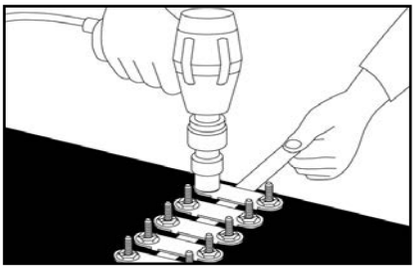
7.Place top plates over bolts using bolt horn.



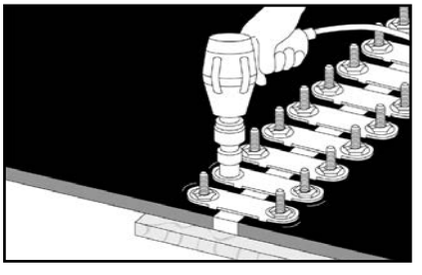
8. Start nuts on bolts by hand.



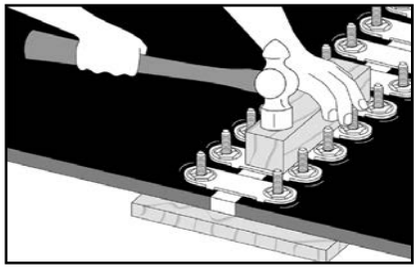
9. Cut Flexco-Lok® Tape 3-1/2 times the belt width and feed tape under top plates, under the bottom plates, then back under top plates.



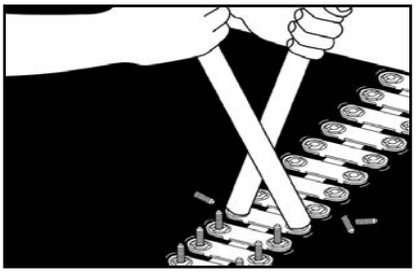
10. Pull tape tight and hold in position by tightening a fastener at each end. Then tighten all other plates.



11. Tighten all fasteners from edges to center. Tighten all nuts uniformly. **NOTE:** A Flexco Power Wrench used with an impact tool will speed this step considerably.



12. Hammer plates in belt with wood block. Retighten nuts.



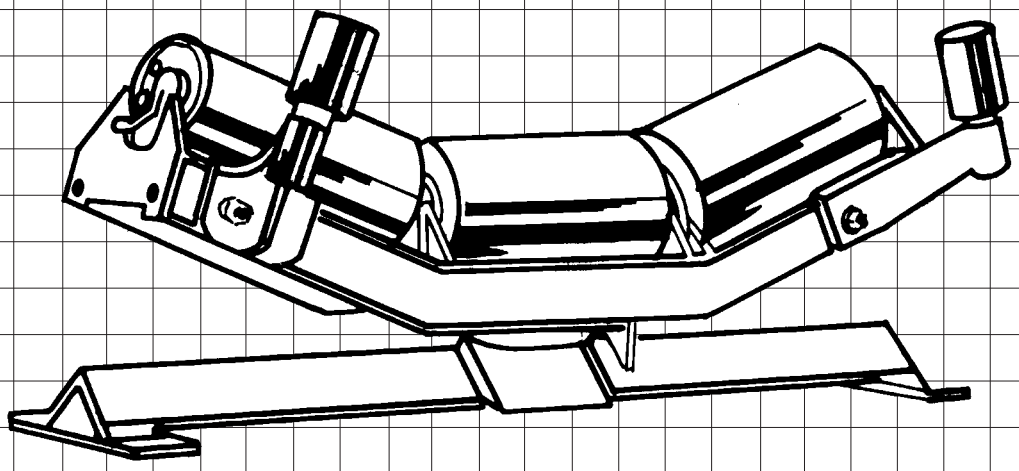
13. Break off excess bolt ends using two bolt breakers. Peen or grind bolts to finish.

FLEXCO

APPENDIX C

FENNER DUNLOP
CONVEYOR BELTING

Belt Tracking



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“Tracking” or training is defined as the procedure required to make the conveyor belt run “true” when empty and also when fully loaded.

Tracking conveyor belt should be approached from a systems point of view. We should first examine some of the components of the conveyor system and see how they effect belt tracking before we discuss the actual methods used to train a belt.

We also need to look at a few non-structural components such as conveyor house keeping, the belt itself and the splice, before we discuss recommended training procedures.

I. Conveyor Components

Supporting Structure

The supporting structure is designed to hold conveyor sections firmly and in proper alignment. If it does not, for whatever reason, it is likely to have an effect on belt tracking. Support structure should be checked as a first step in belt tracking. Has a forklift run into the supporting structure and buckled it? Are the anchors firm?

Conveyor sections are bolted to the supporting structure. They should be “square” and “horizontal” (side to side). If the section is “racked” **it must be straightened**. Measure diagonals across the frame. They should be equal. Repeat for total, assembled bed.

Conveyor bed sections (slider or roller) must be properly aligned with no vertical off-set between sections. A taut line should be stretched over the top surface of the bed and adjustments made so that all points are in contact. The entire bed (and each section) must be horizontal (across the width). If they are not, the belt will be pulled by gravity and will “drift” toward the low side unless a compensating force of some kind is exerted on that belt.

Pulleys/Rollers/Idlers

All pulleys, snub rollers, carrying idlers, and return idlers must be square with the frame (perpendicular to belt center line), parallel to each other and level.

“Squaring” with the frame is a good preliminary adjustment. The final adjustment, however, requires that this “squaring” be done with the belt center line as the reference. All pulleys must be at right angles to the direction of belt travel (belt center line).

Crowns

Crowned pulleys for ***lightweight conveyor belt*** can be trapezoidal or radial shaped. Georgia Duck has products to accommodate both styles, however the amount of crown in either case should not exceed 1/8" per foot on the diameter, and should ***not exceed 1/8" total.*** The rate of crown seems to be very important as well as the total amount of crown
in the system.

On short center conveyors, we recommend no crown on the drive (avoid crowns on drive in every case, unless the drive is an end pulley), and to crown the end pulleys. In a few cases we would also crown additional pulleys, but that will depend on the entire design and the amount of crown used.

Remember, for crowns to be effective, there must be enough free span/transition for the belt to elongate and conform. Pretension to get pulley crown conformation is very important, too much pretension can cause pulley deflection and bearing problems. Georgia Duck has specific carcass constructions to meet very short center, wide belt applications in the 1:1 ratio of length to width, and even less. Please consult factory if you have needs in this area.

Crowned pulleys are not recommended for high modulus bulk haulage belting. Steel Cord belting requires fully machined straight faced pulleys through out the system. If a crowned pulley is used on nylon, polyester or aramid style belting the crown should only be placed in a low tension area such as the tail on a conventional head drive conveyor. The tracking forces that the crown exhibits does not effect high modulus bulk haulage belting because the system lacks enough tension to make the crown effective. If you could exert enough tension on the belt to force the belt to conform to the crown, the belt would be subjected to excessive stretch and splice failure could result.

Take-up

The take-up device in a conveyor belt system has three major functions:

1. To establish, and preferably to maintain a predetermined tension in the belt.

2. To remove the accumulation of slack in the belt at startup or during momentary overloads–in addition to maintaining the correct operating tension.

3. To provide sufficient reserve belt length to enable resplicing, if necessary.

Manual, as well as **automatic**, take-up devices are normally used in a typical conveyor belt system. The **manual or screw** take-up consists of a tension pulley (frequently the tail) which can be moved to tighten the belt by means of threaded rods or by steel cables which can be wound on a winch. These give no indication of the tension they establish and are adjusted by trial methods until slippage is avoided. They are unable to compensate for any length changes in the belt between adjustments and thus, permit wide variation in belt tension. Use is generally restricted to short and/or lightly stressed conveyors–**widely used in unit handling.**

The manual take-up must be such that when tension is applied to the pulley, the pulley remains at right angles to the direction of belt travel. Also the tension must be high enough to allow elastic recovery of elongation due to starting forces, load changes, etc.

Automatic take-ups depend upon suspending a predetermined weight (gravity), by activation of a torque motor, by hydraulic pressure, or by spring loading. These devices maintain a predetermined tension at the point of take-up regardless of length changes resulting from load change, start-up, stretch, etc. This permits running the belt at the minimum operating tension and should be used on all long length conveyors and moderate to highly stressed conveyors.

The automatic take-up alignment must be such that the pulley or pulleys are maintained at right angles to the direction of belt travel. In a gravity or spring loaded take-up, the carriage must be guided to maintain the pulley axis on a line perpendicular
to the belt center line.

Adequate take-up is essential to satisfactory operation of a belt conveyor. The amount required depends on type of belting and on service conditions. Please refer to belt manufacturer for recommendations.

Normally, when a new belt has been properly installed and tensioned, the take-up roll or pulley (automatic take-up) will be initially set at a position of 25% along the line of travel, leaving 75% of the take-up area available for elongation.

II. Non Structural Components

Cleanliness

Cleanliness is essential to good belt tracking. A buildup (of whatever material) on pulleys and rolls can easily destroy the “perpendicularity” of the roll or pulley face. Foreign matter in essence creates a new roll or pulley crown–adversely affecting tracking.

Likewise, cleanliness is essential to slider bed operation. A buildup of foreign materials (or a roughened portion of the slider bed face) can very easily throw a belt off-center since this will result in a differential of warp tensions across the width of the belt. This can seriously effect training.

Scrapers can be applied directly to bend rolls at the take-up area, on a gravity take-up system, to keep the rolls free from build up. Ploughs installed prior to the tail roll, under the loading section, will prevent belt and pulley damage due to carry back.

Balanced/Neutral

It is extremely important that the final belt construction be “balanced” or “neutral” in terms of the internal stresses imparted to the belt during manufacture. Any unbalanced stress remaining in the belt will likely cause problems in tracking.

Typical belt carcass designs usually utilize a plain weave or twill weave. The “crimp” imposed upon the warp yarns (length-wise yarns) in these types of weaves, as well as the warp tension necessary at the loom are difficult to control. Unbalanced stresses can result. Georgia Duck has a patented tensioning system to minimize this problem.

The resulting “straight/balanced” carcass is kept straight by tensioning during the impregnation and curing steps of manufacture, resulting in a straight belt which is balanced and therefore, **easy to track.**

Camber

If unbalanced warp tensions exist in a conveyor belt, that belt will usually assume a “crescent” or “banana” shape when laid flat upon a horizontal surface. This deviation from a straight line is hereby defined as **“camber.”**

To measure belt camber, it is recommended that the belt be unrolled on a flat surface like the warehouse floor, a flat horizontal driveway, etc. Next, one end of that belt should be grasped (and one end only) and the belt dragged in a perfectly straight line for approximately 10 feet. If the belt is too heavy for one man to move, then one end should be clamped to
a forklift and the same procedure performed. At this point, the belt should lie flat. Unequal and unresolved warp tensions in the belt will cause it to assume a “crescent” or “banana” shape.

Camber is measured by drawing a taut line along one edge of the belt and measuring maximum deviation from that taut line to the belt at the point of maximum deviation. Compute % camber as follows:

$$\% \text{ Camber} = \frac{\text{Maximum Deviation (Inches)}}{\text{Length of taut line (Inches)}} \times 100$$

It is recommended that if the percent camber exceeds one-half of 1%, the belt manufacturer be contacted. In lightweight, unit/package handling .25% is the maximum.

Camber can be instilled into a belt during the slitting operation if one of the slitting knives is dull. A dull slitting knife will tear the fill yarns (cross-wise yarns) rather than cut them. (While the belt is in roll form the side of the belt which had gone through the dull knife will exhibit a “fuzzy” appearance due to the torn fill yarns.) Usually this type of camber will be less than one-quarter of 1% and can be pulled out handily when the belt is properly tensioned.

Skew (Bow)

The fill yarns (weft yarns) in the belt carcass will usually lie along the perpendicular to the belt center line. Any deviation from this perpendicular line by the fill yarn is hereby defined as “skew” or “bow.”

A skewed pick in a plain weave or twill weave is cause for concern since it is generally indicative of unbalanced warp tensions and will usually go hand-in-hand with a significant camber.

In a **straight warp** or **solid woven carcass** design, however, **skew is of little significance.** It is a cosmetic defect and is not indicative of a cambered belt.

Belt Tension

Belt tension must be great enough to prevent slippage between the drive pulley and belt. Tension must also be enough to cause the belt to conform to the crowns, if present.

Slippage will cause excessive wear to both drive pulley lagging and the belt. Further, an excessive heat buildup on the drive pulley lagging can result in rubber reversion. (Reversion is the softening of vulcanized rubber when it is heated too long or exposed to elevated temperatures. It is a deterioration in physical properties, and frequently results in tackiness.) Once the pulley **lagging** has reverted, it frequently will offset onto the bottom side of the conveyor belt which will then distribute the reverted rubber throughout the slider or roller bed of the system. The resulting tackiness between the bed and the belt will certainly drive horsepower consumption up; can actually result in a stalled system, and can cause severe tracking problems.

Square Ends

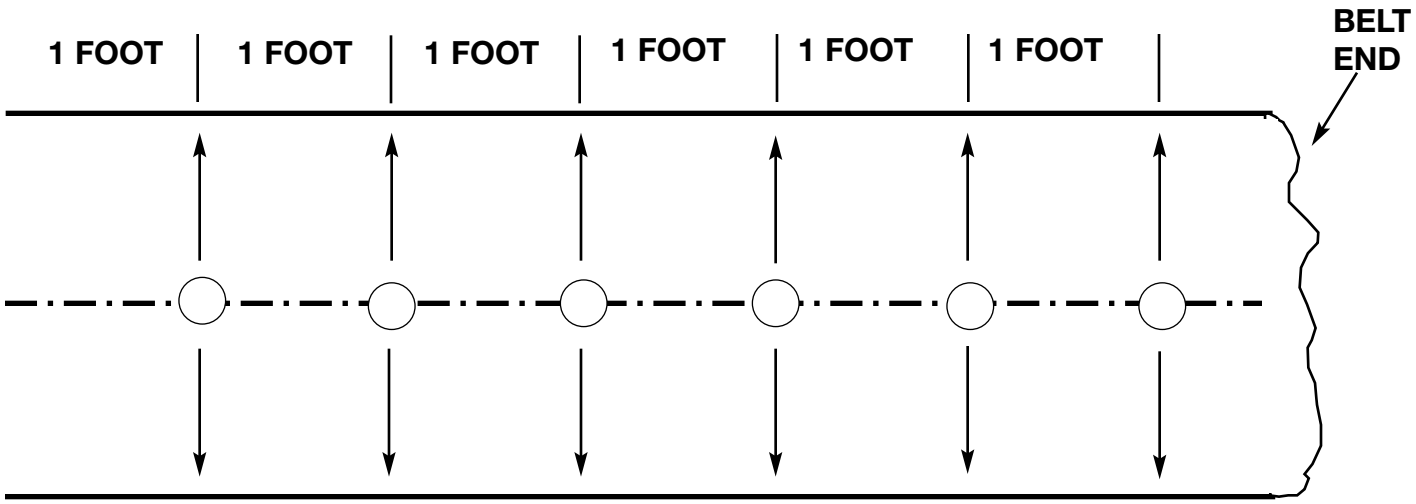
Accurate squaring of the belt ends prior to splicing is essential to belt tracking, and helps distribute stress evenly throughout the splice.

To properly square the belt ends, we recommend the center line method.

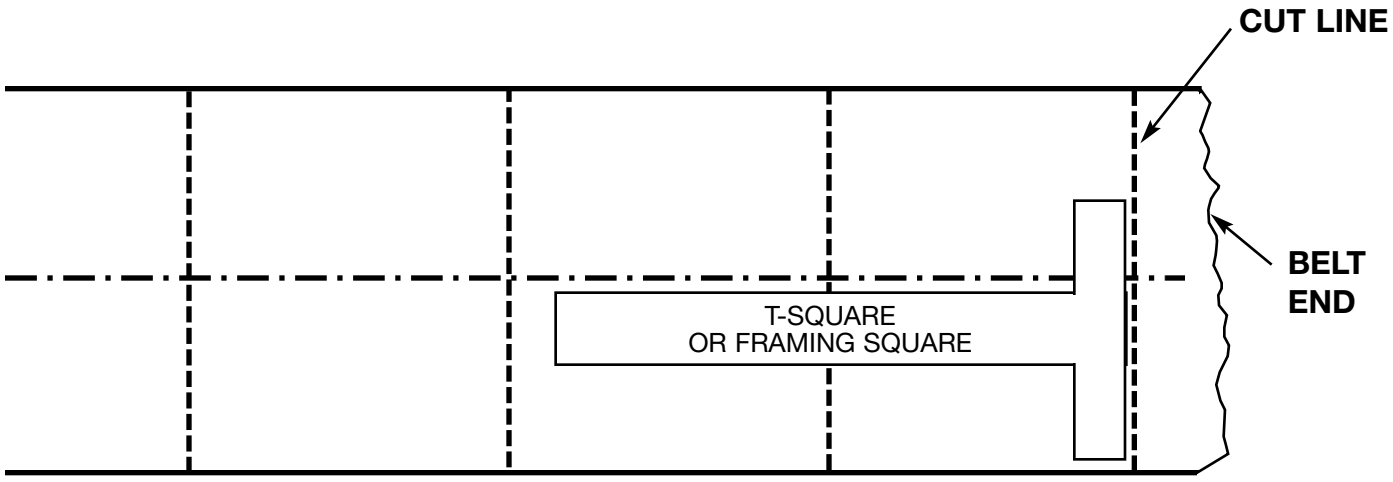
To establish the belt center line, start near the belt end as shown on the next page. Measure the belt width at seven points approximately 1 foot apart. Divide each measurement in two and mark these center points as shown.

Using these seven “center points,” pop a chalk line to form the belt’s center line. Next, using a carpenter square or “T” square, draw a “cut line” across the width of the belt near the belt end as shown. Repeat this for the other belt end.

Using the “cut line” as the guide, cut off the end of the belt with a sharp razor knife. Make sure that the cut is clean and vertical. This operation should then be repeated on the other end of the belt. (Keep in mind that the final belt length may need to include an allowance for such things as diagonal splice, skive taper length, skive overlap, finger punching loss, fastener extension, etc.–depending upon what kind of splice is being performed.)



BELT CENTER LINE



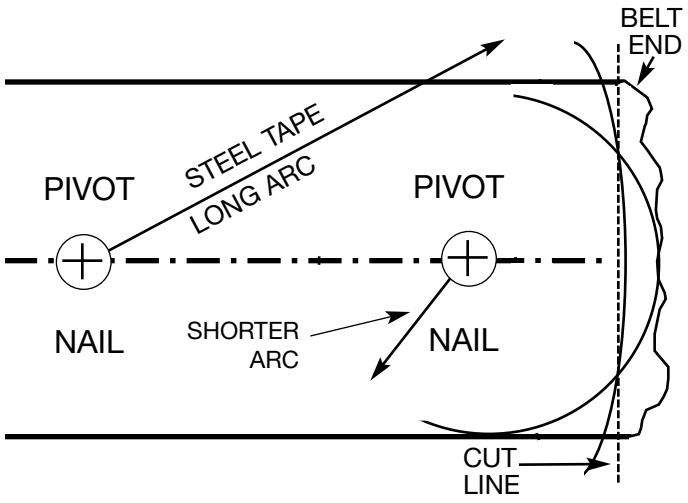
MARKING OF CUT LINE AND OTHER RIGHT ANGLE GUIDE LINES

An alternative method of squaring belt ends is called the “double intersecting arc” method.

First establish the center line as indicated previously. Once that center line has been established, pick a point on the center line and approximately 2 or 3 times the belt width from the belt end. An arc is now struck, as shown in the following sketch.

On bulk haulage belting, a nail can be used as the pivot point and an arc is struck with a steel tape. Always mark the edge of the belt with the same side of the tape.

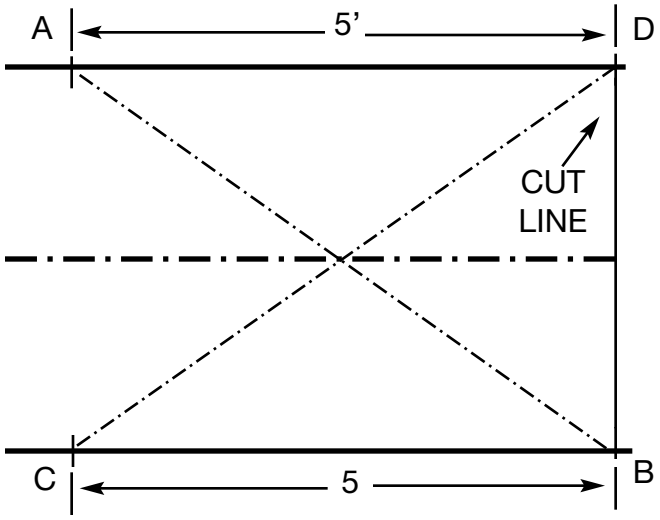
A second arc is now struck as shown. The pivot point in this case is on the center line and is close to the belt end. The arc length is slightly less than one-half of the belt width. Now draw a line from one pair of intersecting arcs to the other. This is the “cut line.” This line is perpendicular to the center line of the belt. The reason for this may be edge wear or damage or to eliminate slitting alignment errors. Never assume both edges are straight and parallel.



ALTERNATIVE ARC METHOD OF SQUARING ENDS

JOINING OF THE POINTS WHERE THE ARCS INTERSECT GIVES THE RIGHT ANGLE CUT LINE

Double Check Squareness



PROVING ACCURACY OF SQUARED-CUT END

LENGTH OF DIAGONAL AB IS EQUAL TO LENGTH OF DIAGONAL DC. ALSO AB AND DC INTERSECT ON THE BELT CENTER LINE.

It is always a good idea to double-check the accuracy of the squared and cut end. Measure 5 feet along each edge from the end of the belt, then utilizing a tape measure, check the two diagonals. They should be equal and further, should intersect on the belt center line.

III. General Tracking/Training Procedures

Tracking the belt is a process of adjusting idlers, pulleys, and loading conditions in a manner that will correct any tendencies of the belt to run other than true.

A normal sequence of training is to start with the return run working toward the tail pulley and then follow with the top run in the direction of belt travel. Start with the belt empty. After tracking is completed, run the belt with a full load and recheck tracking.

Tracking adjustment is done while the belt is running and should be spread over some length of the conveyor preceding the region of trouble. The adjustment may not be immediately apparent, so permit the belt to run for several minutes and at least three full belt revolutions after each idler adjustment to determine if additional "tracking" is required.

After adjustment, if the belt has overcorrected, it should be restored by moving back the same idler, and not by shifting additional idlers or rollers.

If the belt runs to one side at a particular point or points on the conveyor structure, the cause will probably be due to the alignment, or leveling of the structure, or to the idlers and pulleys immediately preceding that particular area, or a combination of these factors.

If a section or sections of the belt run off at all points along the conveyor, the cause is possibly in the belt itself, in the belt not being joined squarely, or in the loading of the belt. With regard to the belt, this will be due to camber. Its condition should improve after it is operated under full load tension. It is a rare occasion when a cambered belt (less than 1/2%) needs to be replaced.

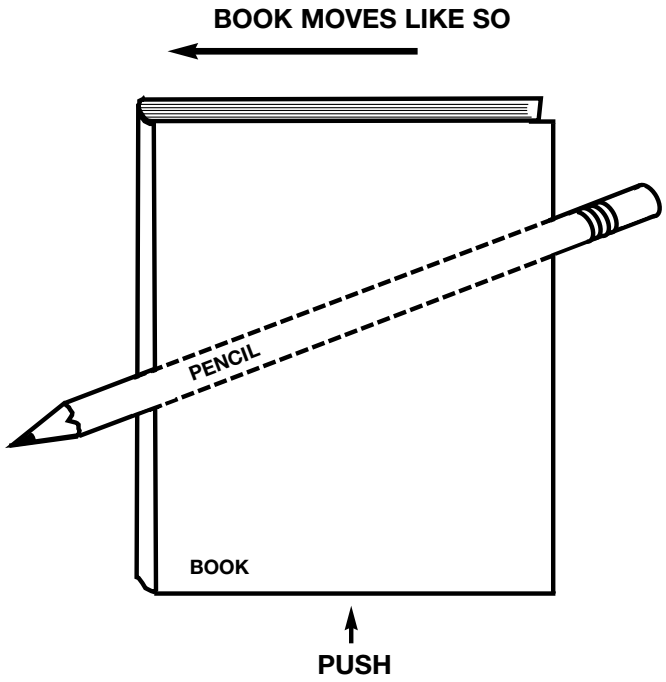
These basic rules can be used to diagnose a belt running poorly. Combinations of these rules sometimes produce cases which do not appear clear-cut as to cause, but if there is a sufficient number of belt revolutions, the running pattern will become clear and the cause disclosed. In those unusual cases where a running pattern does not emerge, it is quite likely that at some point the belt is running so far off that it is fouling structure or mounting brackets, bolts, etc. This results in highly erratic performance and can be a real problem. We would suggest that in this event the full tracking procedure be employed. It is quite likely that the erratic performance will be resolved in the process.

When replacing a used belt, go through the system and square and level all rollers, idlers, pulleys and bed before training a new belt.

Basic/Primary Rule of Tracking

The basic and primary rule which must be kept in mind when tracking a conveyor belt is simple, **"THE BELT MOVES TOWARD THAT END OF THE ROLL/IDLER IT CONTACTS FIRST."**

The reader can demonstrate this for himself very simply by laying a small dowel rod or round pencil on a flat surface in a skewed orientation. If a book is now laid across the dowel rod and gently pushed by one's finger in a line directly away from the experimenter, the book will tend to shift to the left or right depending upon which end of that dowel rod the moving book contacts first.



Pulley Crown on Lightweight and Monofilament Belt

A crowned pulley can be regarded as a special case of our primary rule of tracking as stated above. The right half of the belt is contacting the center of the pulley sooner than it contacts the right edge of that pulley and therefore will tend to move toward the center. The reverse is true of the left half of the belt. The two forces tend to balance one another
by centering the belt.

In addition to this **surface effect,** however, there is a strong internal “balancing of warp tensions occurring.” Consider any warp yarn not directly on the center line. If the belt is forced off-center and this warp yarn is drawn toward the mid-point of the crown, tension will be increased on that yarn. As the belt revolves and that yarn seeks to move back to its normal position, this tension will diminish. Yarns on both sides of the belt seek that position which results in the least stress to themselves, consistent with the physical structure across which they are stressed and consistent with their individual position within the matrix of the belt carcass. Accordingly, the belt will shift on the crowned pulley until these stressing forces are balanced and minimized
–centering the belt.

Experiment has shown that a crown is most effective when it has a long unsupported span of belt approaching the pulley. The lateral position of the belt can be influenced by the crown more easily when there is a minimum of resistance being offered by a supporting slider bed or by supporting idlers.

Georgia Duck goes to great lengths to manufacture balanced carcass belts so that the belt will self center and track on the crown.

In most non-unit-handling conveyors this optimum condition does not exist on the top run and consequently, crown on the head pulley is of little value in training the belt. Further, it is a distinct detriment as far as lateral distribution of tension in the belt is concerned. Head pulleys therefore, should be uncrowned in normal circumstances. Tail pulleys and take-up pulleys which may have a fairly long approaching span without support can be crowned with some beneficial results.

The effectiveness of the crown is increased to a length of approximately 10 feet. Lengthening the unsupported span beyond 10 feet does not seem to increase the effectiveness of the crown. Diminishing the length of the unsupported span on the other hand, does diminish the effectiveness of the crown. The shorter the unsupported span, the less effective the crown will be. Snub pulleys can reduce effectiveness by 50% or more.

We recommend a standard pulley crown of 1/16" on radius per foot of pulley face. This results in an increase in pulley diameter at a point 12" from the edge of the pulley of 1/8" above the edge diameter. A crown of 1/8" per foot should be considered maximum. Crowns may be trapezoidal or radius.

It is further recommended that the crown not be carried beyond a point 18" in from the edge of the pulley. If the pulley width is greater than 36" it is recommended that a trapezoidal pulley be used. In other words, that pulley will have a flat face in its center equivalent to the amount that the pulley width exceeds 36". Radius crowns work, but may take a few minutes longer to stabilize.

With the advent of CNC Machining, we see more use of radial crowns, but the same rule regarding maximum crown should apply. **Special Note:** The belt must stretch to conform to the crown or it will not be effective.

Equipment Induced Camber

Camber can be induced into a perfectly straight belt by the roll or rolls preceding the camber. If the roll is cocked, the belt will react and will move toward that end of the roll which it contacts first. This, of course, throws the belt off-center. If now, subsequent structural adjustments center that roll, the belt installation will be left with a cambered appearance. This camber may be removed by simply aligning the roll or rolls which are cocked.

Specific Training Sequence

Emergency

If the conveyor system, including the belt, has been designed, built and installed according to good engineering and manufacturing practice, the belt should track at start-up. There may be minor variations from the ideal because of manufacturing tolerance–this will simply result in a system in which the belt is not tracking absolutely perfectly, but one in which the belt can be operated without belt damage long enough for the tracking sequence to take place. Normally belt width is less than pulley face width and a small amount of belt movement will
not cause any damage.

Occasionally, there may be a serious maladjustment or defect in the system which will throw the belt off to such a degree as to threaten belt damage. It may actually be necessary to station men at each end of the conveyor and physically force the belt back in line by means of a smooth, steel bar. In extreme cases it may even be necessary to shut the conveyor down, make any adjustment indicated, and then restring and reposition the belt before start-up. In any case, it is extremely important to avoid belt damage. Once a belt is damaged, it will not necessarily recenter itself.

If the conveyor structure has been checked, appears to be true, and all rolls appear to be perpendicular to the system center line and severe belt tracking problems still persist, it is advisable to shut the system down and establish **a belt center line** as
a frame of reference. (Use the technique outlined previously in this discussion.) Now that a belt center line has been established. Use this line as the reference for the adjustment of each individual pulley, snubber, roll, etc. Once all rolls are perpendicular to the belt center line, the belt will track well enough so that the specific training sequence can commence.

(If it was necessary to establish the belt center line, double-check the system structure. Normally, the system center line and belt center line are equivalent. A variance suggests that something has been overlooked in examination of the structure, pulleys, idlers, etc.)

IV. Training Belt on Package or Unit Conveyors

At this point, let us assume that we have a system which is at least operating and with a belt running well enough so that it is not a danger of being damaged. For purposes of our study, let us use the hypothetical conveyor design which follows. Keep in mind that we will follow the general training sequence previously outlined, namely:

1. Return run-working from head toward tail, low tension side.

2. Top run-working from tail toward head, high tension side.

3. First empty, then full; with belt running.

Return Run

Considering the hypothetical conveyor system we have outlined (See Figure #1, page 13), our first consideration will be the first item in the return run–namely, the head pulley snubber (roll #1). From our previous discussion, it is obvious that cocking the head pulley snubber will have very little effect on the tracking since there is essentially no unsupported belt span available to allow the belt to react. However, cocking snubber #1 will tend to throw a camber into the belt which will tend to throw the belt off-center and become apparent at roll #2.

The return idler #2 does have a sufficiently long unsupported span for belt reaction and therefore, cocking idler #2 in a horizontal plane, can have a beneficial tracking effect. (If after we have adjusted idler #2 to the point where the belt is centered on idler #2, examination shows a camber between rolls 1 and 2, this is an indication that roll #1 is not perpendicular to the belt center line and is imparting the camber to the belt in this section.)

If it is necessary to adjust roll #2 to an off-perpendicular position in order to center the belt on roll #2, this off-perpendicular position of roll #2 can cause a subsequent cambering effect. In this particular conveyor design, this cambering effect will be almost totally eliminated by the proximity of roll #3.

If the distance between roll #2 and roll #3 were 8 feet (let us say) this cambering effect could be pronounced. Under these circumstances it may be necessary to compromise and not cock the roll quite as much as we would like. (“Tracking” can be considered a physical embodiment of the art of compromise.)

For purpose of completeness, it should be noted that if one end of roll #2 is lower than the other, the belt will favor that side due to the pull of gravity. This effect may, or may not, be masked by the tracking effect of roll #2.

Idler #3 has little or no tracking effect due to the lack of unsupported span between itself and roll #2. It can, however, be used to control the position of the belt since it does have a cambering effect.

It is important to note at this point that virtually any adjustment you make to these rolls will be slight.

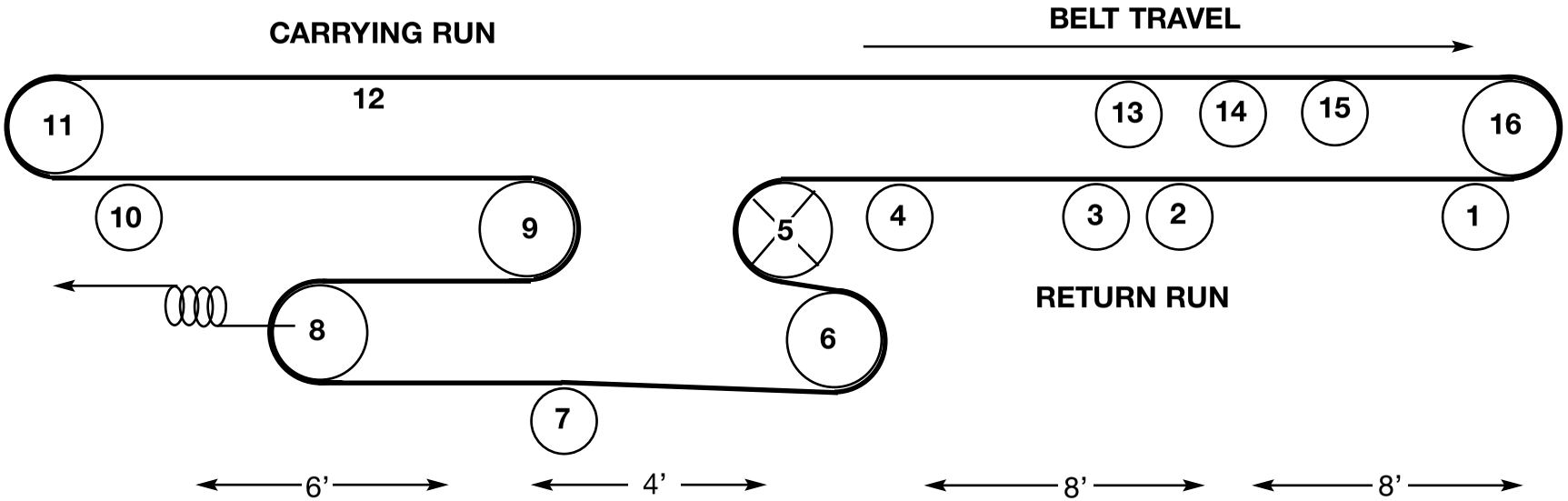
Idler #4 is highly effective as a tracking roll because it does have a good unsupported belt span approaching it. It will induce very little, if any, camber to the belt because of its proximity to roll #5.

Roll #5 on this particular conveyor is our drive pulley and will be a high tension region for the belt. This, coupled with the fact that there is little or no unsupported belt span between itself and roll #4, suggests that this is a poor tracking pulley and should not be crowned. This pulley should be squared to the belt center line and left there. The same is true for roll #6–the snubber pulley.

Roll #7 will not be very effective for tracking purposes because of the short unsupported belt span, but can be a problem camber-wise if it is not perpendicular to the belt center line. This pulley should be square and left there.

The take-up pulley (#8) does have potential for tracking, as well as for camber, due to the unsupported belt span between itself and rolls #7 and 9.

If, however, we adjust roll #8 so it is off-perpendicular in order to achieve a tracking effect on the belt as it approaches roll #8 from roll #7, that same adjustment will tend to impart camber to the belt as it leaves roll #8 and approaches roll #9. Accordingly, compromise is called for and roll #8 should be perpendicular to the belt center line. Unfortunately, this



TRACKING

HYPOTHETICAL CONVEYOR
FIGURE #1

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may not always be possible since roll #8 is a take-up roll and in this case, is spring-loaded. Roll #8 will move from time to time as tensions increase and decrease in the system due to the normal operating cycle. Good engineering practice dictates that roll #8 be constrained in some sort of carriage construction designed to keep it perpendicular to the belt center line at all times. However, there can be tolerance differences, corrosion effects, lack of lubrications, etc., as well as other problems which may, at least momentarily, throw the take-up roll off-square. To avoid the "mistracking effect" this would have, it would be a good idea to impart a self-aligning feature to the take-up roll by crowning it. Further, it is in a low tension portion of the belt circuit and does have a reasonably effective unsupported belt span preceding it.

Roll #9 can exert a reasonable amount of tracking force on the belt because of the unsupported belt span preceding it, but it can also exert a considerable cambering effect since the unsupported belt span between roll 9 and 10 is so large. Here again, compromise is called for–the ideal situation being to simply square pulley #9.

Roll #10 in this design is a snubber and is very important from a tracking point of view. First of all, it has a long unsupported belt span preceding it and therefore is capable of exerting a strong centering influence on the belt. Secondly, the position of this snubber means that it will feed the belt immediately onto the tail pulley and will, in essence, be responsible for positioning of the belt relative to loading. Roll #10 will obviously have little or no cambering effect.

Because of the importance of presenting the belt in a centered manner to the tail pulley, it might be wise to impart a self-aligning feature to roll #10 by crowning it. (Incidentally, this is also a low tension portion of the belt circuit.) Note that the crown will not be as effective as normal due to close proximity of roll #11.

Unless a snub pulley is needed to maintain belt within framework, a snub pulley doesn't serve us well. The snub causes loss of tracking effectiveness with the tail, more belt flex and costs more. Avoid if at all possible.

The tail pulley (roll #11) should be perpendicular to the belt center line. In this particular design adjusting the tail pulley **will have very little, if any, tracking effect** due to the fact that there is no unsupported belt span between itself and roll #10. The snubber roll (#10) in this particular case has taken over the tracking function of the system. If, on the other hand, there were no roll #10, then the tail pulley would in truth have a tracking function and could effectively be crowned.

The tail pulley (#11) does have a marked cambering effect because of the long span between itself and roll #13. It's true that this span is supported by a slider bed which tends to modify the cambering effect. However, since the loading point or points will occur somewhere on this section of the belt and probably quite close to the tail pulley, it is important that the tail pulley be squared relative to the center line so as to avoid any camber whatsoever.

The slider bed (#12) can have a marked effect on belt tracking. The slider bed must be level (side to side) since if it is not level the belt will tend to run toward the low side as it is being pulled by gravity. Further, the slider bed needs to be clean and smooth. If it is rough on one side or it has a layer of gummy, sticky, reverted rubber on one side, it will tend to pull the belt toward that side. In this event, the slider bed should be thoroughly cleaned and buffed. The underside of the belt must also be cleaned (do not use solvent based cleaners on belt).

Carrying idlers #13, #14 and #15 do have tracking and cambering effects based upon their distance from each other, and their distance relative to the slider bed and head pulley. The standard roller bed will have the carrying idlers so close together that individually the rolls will have very little tracking or cambering effects. If, however, they are all cocked in one direction, the effect can be marked. Accordingly, we would urge that carrying idlers not be used for tracking unless absolutely necessary and simply be squared relative to the belt center line.

The discharge pulley (#16) is located in a high tension portion of the belt circuit. Further, there is usually little or no unsupported belt span preceding it, which severely limits any tracking effect which can be obtained from the head pulley. Accordingly, it is good practice not to crown the head pulley nor use it for tracking adjustments. If you find that you must adjust the head pulley in order to center the belt, you will, in all likelihood, find that you have merely realigned an off-square head pulley.

Empty/Full

As each adjustment is made on the individual components of the conveyor system, it is necessary to wait a few minutes, and for a minimum of 2 belt revolutions, in order to give the belt time to react and to observe the true effect of the adjustment you have made. If the belt has over-reacted, do not proceed to another adjustment until you first modify the original adjustment and again, observe its effect.

It is possible that once you have made the entire circuit of the conveyor that adjustments made in the latter part of the sequence may have modified or effected adjustments made earlier in the sequence. It is good practice to double-check by going through the entire sequence again, until the belt is tracking as you wish.

Now that the belt is tracking, the conveyor system should run fully loaded and the tracking sequence repeated.

Ideally, loading should be done in the center of the belt. Unfortunately, however, system parameters may prevent this. In this event, you may find it necessary to modify the original adjustments, so as to compensate for the off-center loading. Here again, compromise is called for. The belt must track empty, as well as full, with as little variation as possible. (Note: Expect some variation–full vs. empty.)

Reversible

In reversible conveyor systems, all idlers should be kept at right angles to the direction of belt travel and any correction necessary made with self-aligning idlers, designed for reversing operations.

It might be profitable to consider our hypothetical conveyor, if the belt were now reversed. (See Figure #2, page 16.)

First of all, our sequence would be altered, since we would now start with roll #10, proceed to 9, 8, etc.

Roll #10 would now be functioning as the head pulley snubber. Any adjustment off the perpendicular of roll #10 would have little tracking effect, because there is no unsupported belt span between #11 and #10. Further, such a deviation from the perpendicular would have a substantial cambering effect. Under the circumstances, therefore, it should be set perpendicular to the belt center line.

Our comments relative to roll #9 through #5 inclusive would be substantially the same as before.

Reaction of roll #4, however, would reverse. Previously, it had a tracking effect and no cambering effect. Now, the reverse is true–it has no tracking effect, but considerable cambering effect. Rolls #3 and 2, likewise, have reversed their actions on the belt. Accordingly, all 3 of these rolls should be left perpendicular to the belt center line.

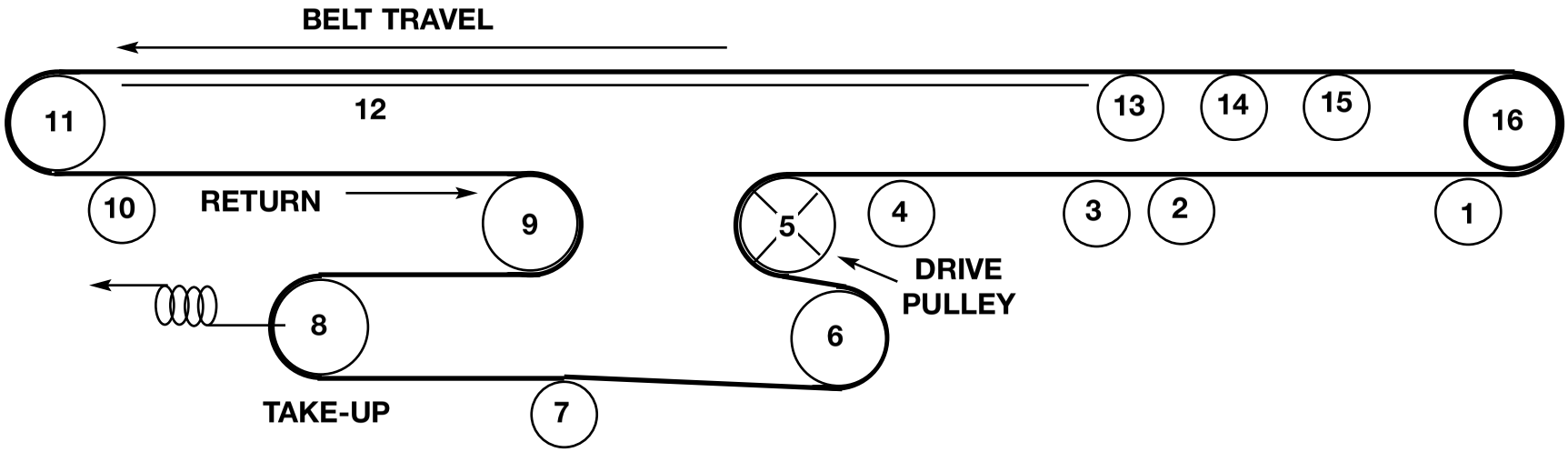
Roll #1 is now the tail pulley snubber rather than the head pulley snubber. Here, again, it has reversed its role and will now exert a significant tracking effect and little cambering effect.

Roll #16 and roll #11 have now reversed positions and accordingly, comments made previously about roll #11 would apply to roll #16 and vice versa.

Comments made previously on items 12 through 15 would essentially hold under these particular conditions.

It is of course, recommended that rolls #11, 13, 14, 15 and 16 simply set perpendicular to the belt center line.

Finally, if this particular conveyor were to be used as a reversible conveyor, serious considerations should be given to replacing return rolls #2 and 3 with a single self-aligning roll. Further, there might be some advantage to crowning both snub rolls (#1 and #10). In this particular case, snub roll #1 would offer considerable tracking effect and would help center the belt on the tail pulley #16. When the belt is reversed, #1 would lose it's tracking capability, but #10 would pick it up. Further, if #1 were indeed perpendicular to the belt line, it would not cause a camber problem. The same can be said for roll #10.



TRACKING

HYPOTHETICAL CONVEYOR
FIGURE #2

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Short Center-Wide Belt Conveyors

Short center-wide belt conveyors offer a special tracking challenge, simply because there usually is not enough belt length to stretch the necessary distance for crown conformation. If belt centers are 10 times belt width, these problems do not normally show up; below 5:1 ratio you must be aware of several factors: (1) Amount and type of crown, (2) belt stress/strain curve, (3) tension on belt and (4) location of crowns in the system.

Georgia Duck has products for lightweight material handling systems for length to width ratios of 1:1 and even below, but these are special and all details of conveyors must be discussed with a Georgia Duck distributor or Georgia Duck representative.

Tracking Priority

Finally, we would like to suggest that when tracking a conveyor belt, number one priority should be given to adjusting return idlers followed by adjustment of snubber rolls. If there is no snubber on the tail pulley, then adjusting the tail pulley does become effective and should be used. The head pulley is normally a flat pulley and should be set on a perpendicular to the belt center line. The head pulley should be adjusted for tracking purposes only as a last resort.

V. Training Bulk Haulage Belting

Training a heavy duty belt is similar in a lot of ways to training a light weight belt.

The major difference is that the troughed idlers on the carry side exert a natural gravitational training force. The edges of the belt that are turned up tend to gravitate toward the center of the conveyor, thereby exerting a powerful training action. Many bulk haulage conveyor operators do not attempt to add any other training devices to the carry side of the conveyor, as the troughers do a fine job by themselves.

As with training light weight belt, all major pulleys: head, tail, drive, snubs, bends, and take-up should be parallel, level and square. All idlers and pulleys need to be clean and functioning properly. All loading stations have to be centered so that product is introduced to the center of the belt. Any belt training idlers that are on the system must be in proper working order and be installed in the proper direction. The lagging on the drive pulley should be inspected and replaced, if the lagging is damaged or if the surface is smooth and hard, which can result in slippage. It is good practice to replace rubber lagging when a new belt is installed, particularly if the lagging is old, as the rubber tends to harden with age and become less effective.

The new belt may have some internal stresses from manufacturing; therefore, the best procedure for a new belt is to run it for a while before making any adjustments. This run-in period will relieve most manufacturing stresses that can occur during weaving, treating, calendering, assembly, curing, and slitting. Some belts, after installation, may run perfectly from the beginning. If the new belt will stay out of the frame on the return side, then run it empty for an hour or two, then begin introducing a load to the belt. The belt should be constantly inspected during this break-in period. Full belt contact with all carry side idlers is important due to the training forces that are present with the troughed idler sets.

As stated in the beginning of this brochure, crowned pulleys are not required for bulk haulage belting. Crowned pulleys may offer a minor contribution towards training when the crowned face is used on a low-tension pulley like the take-up or the tail pulley. The crown will have no effect if used on the high tension head pulley or drive pulley. High modulus belt fabrics like nylon, polyester, and aramid do not respond to the centering forces of crowned pulleys; and in some cases, can actually have an adverse effect on the belt. Steel cord belts must have fully machined straight faced pulleys to operate around, because a crown will create adverse stresses in the belt and in the splice.

The theory of training a heavy duty belt is to feed the carry side square, use the troughers to keep the belt centered through the discharge, then train the empty belt on the return (slack side).

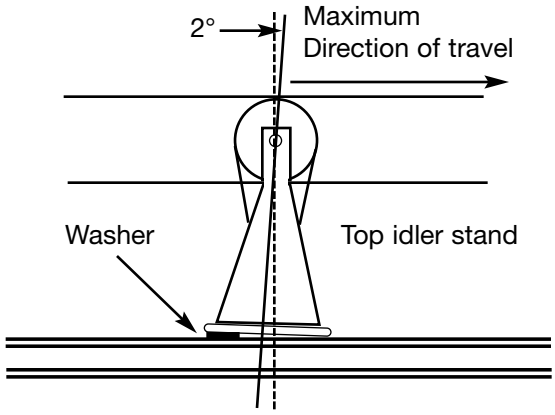
Self-training idlers should be on 100' centers on the return side, unless the conveyor is out of square, then 50' centers may be required in areas where the frame is out of square. The locations of the self-trainers are very important, as they can not function properly if installed in the wrong place.

The first self-training idler on the return should be placed about 30' behind the head. This allows the training idler to align the belt coming out of the head (into the trainer). . .then 30' past the trainer. Self-training idlers do not work when placed too close to a terminal pulley, snub, bend or take-up. These pulleys have more belt wrap than the training idler, which off-sets any training forces that the idler has. You need at least 30' of free run on each side of the training idler to make it effective. On slow-moving belts, 20' of free area on each side will work. At 800' per minute, the self-training idler should be placed 40' from a major pulley. The trainers can then be spread out over the return. If the take-up is 80' behind the head, place one self-trainer between the head and take-up areas, after the take-up area (20' to 40'); then place the trainers on 100' centers back to within 20' to 40' of the tail. If the self-training return idlers are still not effective, shim the return trainers up to present the trainer with more belt surface area. Equally effective is to use the next size up return run self-trainer–a 5" dia. to a 6" dia. trainer. A good rule of thumb is never skew an idler that has over 90° of wrap, to ensure that the high modulus belt fabric will not be stretched out of square. This method will train the slack side belt,

feed the tail square, then run true on the carry side because of the centering forces from the troughers. Self-training troughing idlers should not be shimmed up because the additional pressure that is created on the belt in the idler gap area can cause premature belt failure in the idler junction area.

Another approach to training the slack side of long centered conveyors is the use of 2 roll “V” return idlers. With this type idler (generally 10°), gravity becomes the training force, and the belt edges are not subject to wear from the vertical arms on self-trainers. It should be noted that due to the small degree of angle with this type of return idler, if the frame is severely out of square the belt can run out of the “V” and into the return frame.

In areas along the carry side where the frame is not level and true, the following additional training method can be used. Each individual idler stand can be tilted in the line of travel by placing a washer under the rear legs of the idler stand. This forward tilt is not to exceed 2° from vertical. This is **NOT** to be done with reversing conveyors. The negative side of this training method is that excessive wear on the pulley cover and on the idler can result since the idler is no longer rotating on an axis 90° to the belt path.



Feeder Belts

Short centered feeder belts should be double-checked for squareness with a steel tape. The two terminal pulleys need to be parallel, level and square.

All training should be done on the return, or slack side. On a short conveyor (50' centers, or so) place one large diameter self-trainer on the return side in the middle of the conveyor. This roll can be shimmed up to increase the effectiveness of the roll.

The most important part of the tracking is not to use major pulleys for training; and to allow the trainer to have slack belt feeding into and out of the trainer.

Bi-Directional Belts

Bi-directional belts should only use carry side troughers that are vertical and do not have any tilt added in. All return run self-trainers should be of the bi-directional type.

Bi-directional hardware, such as pulleys, top side idlers and return side idlers must be level, parallel and square.

When pulling the load towards the drive pulley, the tight side is on the carry side and the slack side is on the return. When pulling from the return side, ie., pushing the load, the tight side is on the return and the slack side is on the carry side.

The slack side of the belt will have more catenary, ie., loose belt, to drape over the idlers than the tight side; therefore the idlers on the slack side will have a more influential training effect than idlers on the tight side, ie., less drape over the idler. Therefore it is mandatory that all idlers be level and square.

Skewing an idler on the tight side will allow certain training advantages. When the conveyor reverses, this same idler is now on the slack side, and will have more catenary, or drape, and will now have a greater influence than before.

The reader should also keep in mind another potential problem, when trying to train a bi-directional bulk haulage conveyor. A carry side trougher, when skewed, will have minimum effect when the belt is run empty and pulled over the idler. This same trougher with a load being pulled over it, now becomes even more influential, due to the weight on the belt forcing the belt down on the idler. If you now push the belt in the opposite direction with a load on it, this same idler has an even greater training effect.

These are some of the reasons that make training bi-directional conveyors so difficult. Therefore, all hardware must remain level and square and the use of bi-directional self-trainers is a must.

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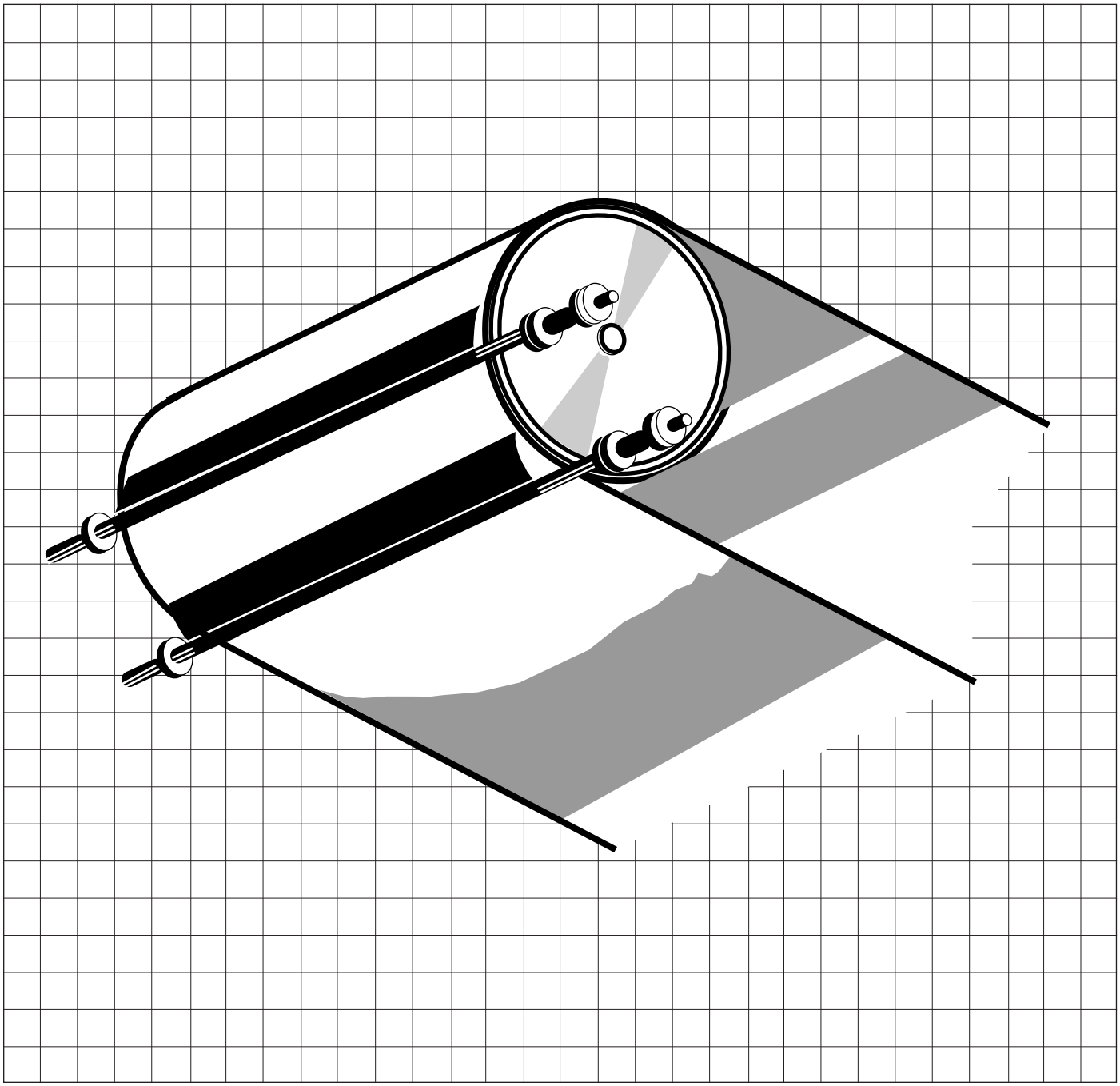
APPENDIX D

FENNER DUNLOP
CONVEYOR BELTING

Conveyor Belt Maintenance



Conveyor belt maintenance not only includes proper care of the belt itself but also includes care and maintenance of the frame and accessories.

The first step in the process is to design an inspection form to encompass all aspects of each conveyor. This brochure is designed to assist in the actual design of the inspection report and the steps needed to correct any problems that you see when making this inspection.

This inspection form will take into account various types of conveyors from package handling to bulk haulage, therefore some of the items covered in our inspection and repair report may not apply to your particular conveyor.

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II. Belt Running Empty.....4

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I. Belt Shut Down and Empty

The first step is to inspect the conveyor belt when the system is shut down and empty. This allows the opportunity to check for any damage to the belt or splice. The conveyor should be locked out while making this inspection.

Rubber belt damage should be repaired using the hot vulcanized repair method or the cold repair method. Belt fabrics that are exposed to the weather or to product contamination should be properly cleaned, dried, then covered with new rubber. These repairs are critical to prevent moisture from penetrating the belt and breaking down the cover adhesions, and to prevent
product contamination from abrading the carcass and also breaking down the adhesions. Very few, if any repairs can be made to lightweight belts.

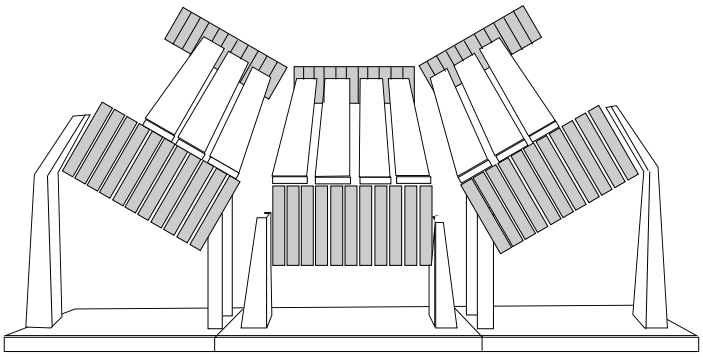
The splice can also be inspected and if damage in the splice is visible it is suggested that the splice be repaired or replaced.

This is also a good time to walk the conveyor and check the following components.

A) Tail Pulley free from build-up and trapped material

B) Tail Pulley damage

C) Skirting in the loading area



D) Impact Bed or Impact Idler damage
E) Slider Bed clean and smooth

F) Carrying Side Idler damage

G) Carrying Side Self Trainers - operational and not tied off

H) Secondary Loading Stations

a) Skirting

b) Impact Bed or Impact Idler damage

I) Tripper Frame damage

J) Tripper Discharge Pulley - clean

K) Tripper Bend Pulleys - clean

L) Head Pulley and/or Drive Pulley

a) Clean

b) Check for worn lagging

c) Re-lag Drive Pulley if rubber is old, worn, smooth and hard

M) Head Pulley cleaner or scraper - operational

N) Head Pulley Snub - clean

O) Return Idlers - clean & turning freely

P) Bend Pulleys - clean

Q) Take-Up - clean

R) Return Side Self Trainers - operational and not tied off

S) Damage to return side frame due to mistraining

T) Plow or Scraper in front of Tail Pulley - operational

The preceding list should be used as a guide when inspecting the conveyor while it is empty

and shut down.
Numerous items in the preceding list contained the words clean or operational. Pulleys or idlers that have build up on them will cause tracking problems. The same can be said for pulleys that have some of the rubber lagging worn off.

Scrapers, plows and self-trainers must be operational to perform their tasks. Belt damage, pulley damage and tracking problems will result if these accessory pieces of hardware are not
maintained.

II. Belt Running Empty

The conveyor should be turned on and run empty. The purpose of this is to walk the conveyor, while running empty, to check for any tracking problems. Before any adjustments are made to correct a tracking problem, the system will need to be inspected under running conditions when loaded, because empty belts and loaded belts do not necessarily track the same way. For more information on tracking, refer to the Georgia Duck Tracking Brochure.

III. Belt Running Loaded

The next step in our inspection process is to run the belt in a loaded condition. We will add a few new steps in the inspection process and repeat a few of the previous steps.

The following is our check list for operating the conveyor while loaded:

A) Tail Pulley - Turning freely without bearing noise, product build up or carryback; belt tracking satisfactorily

B) Load area spillage

C) Carry Side Idlers - turning freely

D) Carry Side Self-Trainers - functioning

E) Secondary Loading Station spillage

F) Tripper Area

   a) Tracking

   b) Spillage

G) Head Pulley and or Drive Pulley

   a) Smoothly running

   b) Slippage when starting or running

   c) Belt Cleaners - functioning

   d) Belt Tracking

H) Head Pulley Snub - turning freely without bearing noise and clean

I) Return Idlers - clean and turning freely

J) Bend Pulleys - turning freely without bearing noise and clean

K) Take-up Pulley - turning freely without bearing noise, clean, moving freely in the frame

L) Return Side Self Trainers - functioning

M) General Belt Tracking

N) Plow or Scraper in front of Tail Pulley - functioning

IV. Corrective Action

The last step is to take the corrected action required on the conveyor in addition to:

A) Clean Up

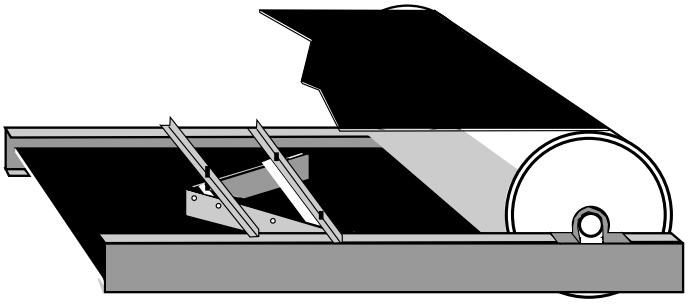
B) Lubrication

C) Safety Concerns - such as installing or repairing conveyor crossovers, safety stop cables, holdbacks on incline conveyors, edge limit switches, motor guards, hand rails, etc.

We have mentioned the word cleanliness throughout this brochure. Maintaining a clean system can not be stressed enough.

A conveyor system with carryback on the return side is the single biggest reason that conveyor belts are replaced, return idlers and pulleys are replaced and structure is worn through. Material build up on the belt and hardware causes tracking problems, that will lead to edge damage, that leads to new belt and new idlers.

We urge you to use scrapers on the head pulley and plows in front of the tail pulley as preven-



tion for damage in your maintenance planning.

Some sticky materials present a real challenge when it comes to preventing carryback. We would like to offer a few additional suggestions as to handling these products.

Cleated belts may be reversed to allow better release at the discharge point.

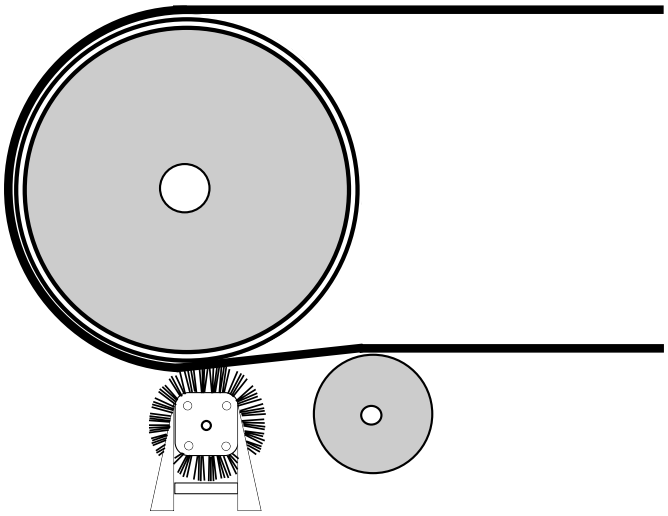
A dual scraper system on the head pulley is the most common way to eliminate product carryback.

A water spray on the belt cover along with wiper blades will effectively remove most products from sticking to the cover.

A series of out of round (cam shaped) return idlers will also assist in cleaning. These idlers are spiral wound from the edges towards the center of the idler and work on the premise of a turning beater bar arrangement.

A compressed air blast has been successfully used on material like coal and fine wet sand.

A power driven revolving brush will help remove product from the belt. This method is rarely used because the bristles tend to clog up with



material and wear out quickly. A brush may be the only solution for cleated belts.
Product build up on return side pulleys is a major concern. If your belt is not effectively clean on the return run, then any bend pulleys or head snub pulley that come in contact with the carry side of the belt will accumulate product. We would like to offer a few hints on pulley and idler cleaning.

All return side pulleys that come in contact with the carry cover can be lagged with a soft rubber vulcanized to the pulley. The constant flexing action of the soft lagging will cause material to fall off and reduce material accumulation.

A lever weighted urethane scraper pressed against the pulley face, is an excellent way to remove build up. This system causes additional wear on the pulley face so it is suggested to use heavier walled return bend pulleys when using a scraper. If a scraper is applied to a head snub or bend pulleys at the take-up
area then deflector plates will have to be installed to deflect he build up away from the belt.

Return idlers can be rubber covered and will help prevent product from sticking to the return idlers.

Return idlers can be purchased that are nothing more than discs mounted on a shaft. These discs can be made of soft rubber, urethane, or ceramics. This type of return idler can be very effective to prevent build up. The major problem when using this style of return roller is that the manufacturers do not put enough discs on the shaft to effectively support the belt in the middle, and support the edges of the belt if any mis-tracking occurs.

Another effective measure is called a turnover system. By the use of a series of rollers the belt is flipped over at the head and tail on the return side. This allows the belt to run the return side with the carry (dirty side) side up and the pulley
(clean side) side down in contact with the return rollers. Any spillage from the product carryback will be limited to the two twist areas. For more information on turnover systems, refer to our brochure on Conveyor Design Tips.

The following inspection form and checklist should be used as a guide for your conveyor systems. There may be additions or deletions depending on your particular conveyor designs.

CONVEYOR INSPECTION FORM AND CHECKLIST

Inspection Date _____ Conveyor Number_____

I. Belt Shut down and Empty — Corrective Action

_____ Belt Condition

_____ Splice Condition

_____ Tail Pulley

_____ Skirting

_____ Impact Bed/Idlers

_____ Slider Bed

_____ Carry Side Idlers

_____ Carry Side Self Trainers

_____ Secondary Loading Station

_____ Tripper Frame

_____ Tripper Discharge Pulley

_____ Tripper Bends

_____ Head / Drive Pulley

_____ Head Pulley Cleaner

_____ Head / Drive Pulley Snub If Present

_____ Return Run Drive

_____ Return Idlers

_____ Bend Pulleys

_____ Take-Up Pulley

_____ Return Side Self Trainers

_____ Return Side Frame

_____ Tail Pulley Plow / Scraper

II. Belt Running Empty — Corrective Action

_____Tracking

III. Belt Running Loaded

_____ Tail Pulley

_____ Spillage in Load Area

_____ Carry Side Self trainers

_____ Secondary Load Station Spillage

_____ Tripper Area

_____ Tracking

_____ Spillage

_____ Head Pulley

_____ Drive Pulley

_____ Head Pulley Cleaner

_____ Head / Drive Pulley Cleaner

_____ Head / Drive Pulley Snub

_____ Return Idlers

_____ Bend Pulleys

_____ Take-Up Pulley

_____ Return Side Self Trainers

_____ Belt Tracking

_____ Tail Pulley Plow / Scraper

IV. Corrective Action

_____ Clean Up

_____ Lubrication

_____ Safety

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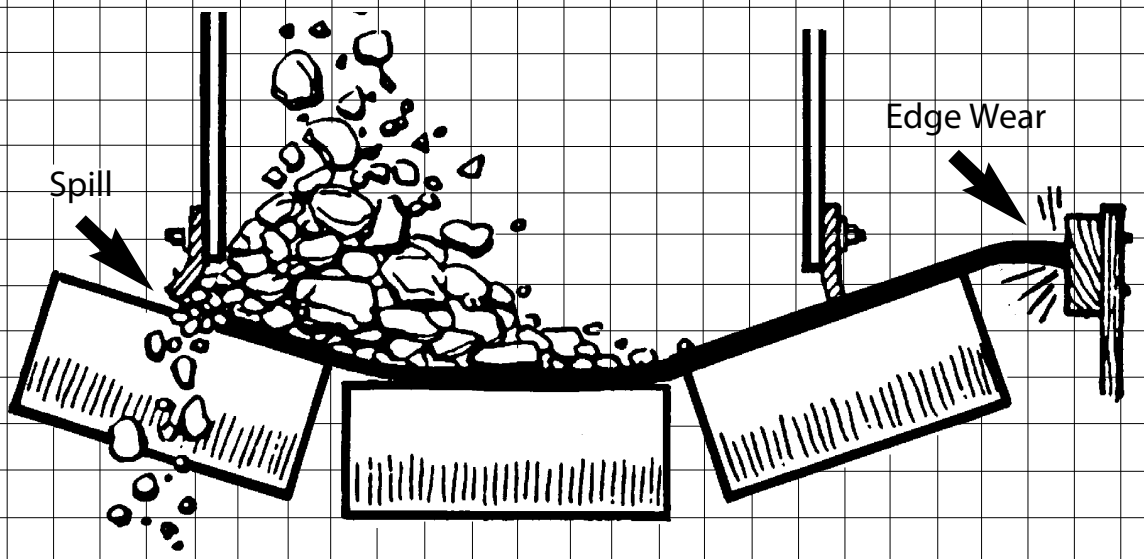
APPENDIX E

FENNER DUNLOP
CONVEYOR BELTING

Trouble Shooting



Effects of Off-Center Loading

The enclosed conveyor belt trouble shooting chart can serve as a general guide for some of the more common conveyor belt problems.

If your belt problem does not seem to resolve itself with these corrective measures, or if your belt problem is not found on this list, then contact Georgia Duck and request a visit by one of our factory representatives.

* The idler junction is the gap between the functioning surfaces of the center roll and one of the side rolls of the idler (See Fig. 1). This gap poses a potential hazard for the belt by providing a narrow space in which the belt can settle experiencing highly detrimental flex and possible exposure to oil or grease from the idler bearings (Fig. 2). When slipping of the belt into the idler junction is the cause of belt damage, it is called idler junction failure. The idler gap should be less than .4” or twice belt thickness-whichrever is less.

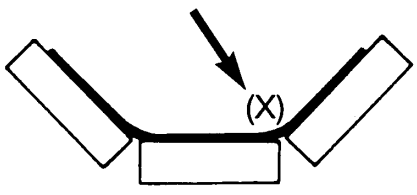


Fig. 1

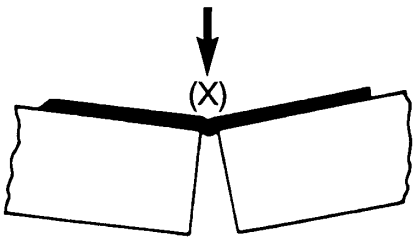


Fig. 2

Trouble Shooting

Problem/Cause	For Solutions Refer to Answer #					
A. Belt runs off at tail pulley.	39	10	1	19	31	
B. Belt runs to one side for long distance or entire length of conveyor.	39	8	5	1		
C. Particular section of belt runs to one side at all points on conveyor.	6	7	46			
D. Belt runs off at head pulley.	33	10	1	3		
E. Conveyor runs to one side at given point on structure.	5	4	1	2	3	44
F. Belt runs true when empty, crooked when loaded.	8	51	52			
G. Belt slips.	34	33	31	10	4	30
H. Belt slips on starting.	34	31	33	30	42	43
I. Excessive belt stretch.	12	35	32	43		
J. Grooving, gouging or stripping of top cover.	13	4	15	16	53	
K. Excessive top cover wear, uniform around belt.	19	20	10	8	36	
L. Severe pulley cover wear.	4	9	10	17	1	27
M. Longitudinal grooving or cracking of bottom cover.	4	10	9	33	36	
N. Covers harden or crack.	23	37				
O. Cover swells in spots or strreaks.	21					
P. Belt breaks at or behind fasteners; fasteners pull out.	24	22	48	30	47	49
Q. Vulcanized splice separation.	38	30	12	17	25	
R. Excessive edge wear, broken edges.	8	10	40	7	50	38
S. Transverse breaks at belt edge.	18	25	26			
T. Short breaks in carcass parallel to belt edge, star breaks in carcass.	16	17				
U. Ply separation.	29	30	23			
V. Carcass fatigue at idler junction.*	25	26	27	28	29	36
W. Cover blisters or sand blisters.	45	21				
X. Belt Cupping-Old Belt (was OK when new).	21	23				

Conveyor System Problems/Causes and Their Solutions

1. Idlers or pulleys out-of square with center line of belt: readjust idlers in affected area.
2. Conveyor frame or structure crooked: straighten in affected area.
3. Idler stands not centered on belt: readjust idlers in affected area.
4. Sticking idlers: free idlers and improve maintenance and lubrication.
5. Build-up of material on idlers: remove accumulation; improve maintenance. Install scrapers or other cleaning devices.
6. Belt not joined squarely: remove affected splice and resplice.
7. Bowed belt: for new belt this condition should disappear during break-in; in rare instances belt must be straightened of replaced; check storage and handling of belt rolls.
8. Off-center loading or poor loading: adjust chute to place load on center of belt; discharge material in direction of belt travel at or near belt speed.
9. Slippage on drive pulley: increase tension through screw take-up or add counterweight; lag drive pulley; increase arc of contact.
10. Material spillage and build-up: improve loading and transfer conditions; install cleaning devices; improve maintenance.
11. Bolt heads protruding above lagging: tighten bolts; replace lagging; use vulcanized-on lagging.
12 Tension too high: increase speed, same tonnage, same speed; reduce friction with better maintenance and replacement of damaged idlers; decrease tension by increasing arc of contact or go to lagged pulley; reduce CWT to minimum amount.
13. Skirt boards improperly adjusted or of wrong material: adjust skirt board supports to minimum 1” between metal and belt with gap increasing in direction of belt travel; use skirt board rubber (not old belt).
14. Load jams in chute: redesign chute for proper angle and width.
15. Material hanging up in or under chute: improve loading to reduce spillage; install baffles; widen chute.
16. Impact of material on belt; reduce impact by improving chute design; install impact idlers, or impact bed.
17. Material trapped between belt and pulley: install plows or scrapers on return run ahead of tail pulley.
18. Belt edges folding up on structure: same corrections as for 1, 2, 3; install limit switches; provide more clearance.

19. Dirty, stuck, or misaligned return rolls: remove accumulations; install cleaning devices; use self-cleaning return rolls; improve maintenance and lubrication.

20. Cover quality too low: replace with belt of heavier cover gauge or higher quality rubber or other elastomer.

21. Spilled oil or grease: over-lubrication of idlers: improve housekeeping; reduce quantity of grease used; check grease seals

22. Wrong type of fastener, fasteners too tight or too loose: use proper fastener and splice technique; set up schedule for regular fastener inspection.

23. Heat or chemical damage: use belt designed for specific condition.

24. Fastener plates too long for pulley size: replace with smaller fasteners; increase pulley size.

25. Improper transition between troughed belt and terminal pulleys: adjust transition in accordance with Georgia Duck Belting Catalog.

26. Severe convex (hump) vertical curve: decrease idler spacing in curve; increase curve radius.

27. Excessive forward tilt of trough rolls: reduce forward tilt of idlers to no more than 2° from vertical.

28. Excess gap between idler rolls: replace idlers; replace with heavier belt.

29. Insufficient transverse stiffness: replace with the proper belt.

30. Pulleys too small: use larger diameter pulleys.

31. Counterweight too light: add counterweight or increase screw take-up tension to value determined from calculations.

32. Counterweight too heavy: lighten counterweight to value required by calculations.

33. Pulley lagging worn: replace pulley lagging.

34. Insufficient traction between belt and pulley: lag drive pulley; increase belt wrap; install belt cleaning devices.

35. System underbelted: recalculate belt tensions and select proper belt.

36. Excessive sag between idlers causing load to work and shuffle on belt as it passes over idlers: increase tension if unnecessarily low; reduce idler spacing.

37. Improper storage or handling: refer to Georgia Duck for proper storage or handling instructions.

38. Belt improperly spliced: resplice using proper method as recommended by Georgia Duck.

39. Belt running off-center around the tail pulley and through the loading area: install training idlers on the return run prior to tail pulley.

40. Belt hitting structure: install training idlers on carrying and return run.

41. Improper belt installation causing apparent excessive belt stretch: pull belt through counterweight with a tension equal to at least empty running tension; run belt in with mechanical fasteners.

42. Improper initial positioning of counterweight in its carriage causing apparent excessive belt stretch; check with Georgia Duck for recommended initial position.

43. Insufficient counterweight travel: consult Georgia Duck for recommended minimum distances.

44. Structure not level: level structure in affected area.

45. Cover cuts or very small cover punctures allow fines to work under cover and cut cover away from carcass: make spot repair with vulcanizer or self-curing repair material.

46. Worn edge: ”press” edge.

47. Interference from belt scrapers: adjust belt scrapers.

48. Tension too high for fasteners: use vulcanized splice.

49. Belt carcass too light: select stronger carcass.

50. Belt misalignment: see training recommendations.

51. Variations in nature and formation of load: use notched chute to keep load peak in exact center of belt.

52. Belt not making good contact with all idlers: adjust height so all idlers contact belt.

53. Sharp edges of material or tramp iron coming in contact with cover: use jingle bars, impact idlers, magnetic removal equipment.

FENNER DUNLOP

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ISO 9001:2000 Certified

10/03

APPENDIX F

TORQUE-ARM Shaft Mount Speed Reducers

Lubrication of TORQUE-ARM Reducers

CAUTION: Unit is shipped without oil. Add proper amount of rust and oxidation inhibited (R & O) gear oil before operating. Failure to observe these precautions could result in damage to, or destruction of, the equipment.

Lubrication is extremely important for satisfactory operation. The proper oil level as shown in Table 3 must be maintained at all times. Frequent inspections with the unit not running and allowing sufficient time for the oil to cool and the entrapped air to settle out of the oil should be made by removing the level plug to see that the level is being maintained. If low, add the proper type and viscosity of lubricant through one of the upper openings until it comes out of the oil level hole. Replace the oil level plug securely. Refer to Tables 1 and 2 for viscosity recommendations.

After an initial operation of about two weeks, the oil should be changed. If desired, this oil may be filtered and reused. Very often, small metal particles will show up in the oil due to the wearing in process. After the initial break-in period, the lubricant should be drained, magnetic drain plug cleaned, gear case flushed and refilled every 2500 hours of operation under average industrial conditions.

CAUTION: Too much oil will cause overheating and too little will result in gear failure. Check oil level regularly.

More frequent oil changes are recommended when operating continuously or at high temperatures or under conditions of extreme dirt or dust. Use only recommended lubricants listed on this page, or equivalent. Special attention should be given to checking of lubricants when any of the following conditions exist:

1. High operating temperatures resulting from heavy intermittent loads causing the temperature of the gear case to rise rapidly and then cool.
2. Unusual ambient conditions, which may tend to cause condensation on the inside of the gear case thereby contaminating the oil.
3. Operating temperatures that would cause oil to approach 200°F continually.
4. Subjection of reducer to unusual vapors or moist atmosphere.
5. Subjection of reducer to extremely dusty or dirty environment.

Under these extreme operating conditions, the oil should be changed every 1 to 3 months depending on severity of conditions.

Operating Temperatures

Heating is a natural characteristic of enclosed gearing, and a maximum gear case temperature approaching 200°F is not uncommon for some units operating in normal ambient temperatures (80°F). When operating at rated capacity, no damage will result from this temperature as this was taken into consideration in the design of the gear case and in the selection of the lubricants.

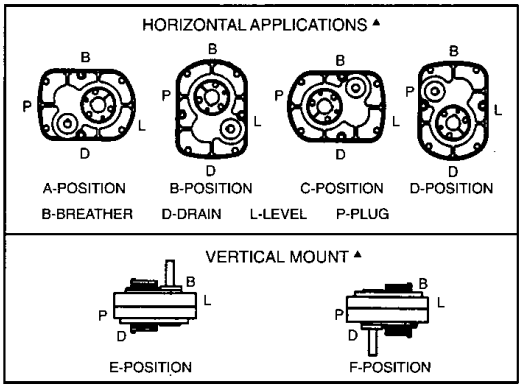
Horizontal Installations

Install the magnetic drain plug in the hole closest to the bottom of the reducer. Throw away the tape that covers the filler/ventilation plug in shipment and install plug in topmost hole. Of the remaining plugs on the sides of the reducer, the lowest one is the minimum oil level plug.

The running position of the reducer in a horizontal application is not limited to the four positions shown. However, if running position is over 20° either way from sketches, the oil level plug cannot be safely used to check the oil level, unless during the checking the torque arm is disconnected and the reducer is swung to within 20° of the positions shown. Because of the many possible positions of the reducer, it may be necessary or desirable to make special adaptions using the lubrication fitting holes furnished along with other standard pipe fittings, stand pipes and oil level gauges as required.

Vertical Installations

Install the filler/ventilation plug in the hole provided in the top face of the reducer housing. Use the hole in the bottom face for the magnetic drain plug. Of the remaining holes on the sides of the reducer, use a plug in the upper housing half for the minimum oil level plug.



▲ **NOTE:** Below 15 RPM output speed, oil level must be adjusted to reach the highest oil level plug (P).

Table 1 — Lubrication Recommendations — ISO Grades For Ambient Temperatures of 50°F through 125°F*

Output RPM	TXT, SCXT, HXT Reducers													
	1	2	3	4	5	6	7	8	9	10	12	13	14	15
301-400	320	320	220	220	220	220	220	220	220	220	220	220	220	220
201-300	320	320	220	220	220	220	220	220	220	220	220	220	220	220
151-200	320	320	220	220	220	220	220	220	220	220	220	220	220	220
126-150	320	320	320	220	220	220	220	220	220	220	220	220	220	220
101-125	320	320	320	320	220	220	220	220	220	220	220	220	220	220
81-100	320	320	320	320	320	220	220	220	220	220	220	220	220	220
41-80	320	320	320	320	320	220	220	220	220	220	220	220	220	220
11-40	320	320	320	320	320	320	320	320	320	320	220	220	220	220
1-10	320	320	320	320	320	320	320	320	320	320	320	320	320	320

Table 2 — Lubrication Recommendations — ISO Grades For Ambient Temperatures of 15°F through 60°F*

Output RPM	TXT, SCXT, HXT Reducers													
	1	2	3	4	5	6	7	8	9	10	12	13	14	15
301-400	220	220	150	150	150	150	150	150	150	150	150	150	150	150
201-300	220	220	150	150	150	150	150	150	150	150	150	150	150	150
151-200	220	220	150	150	150	150	150	150	150	150	150	150	150	150
126-150	220	220	220	150	150	150	150	150	150	150	150	150	150	150
101-125	220	220	220	220	150	150	150	150	150	150	150	150	150	150
81-100	220	220	220	220	220	150	150	150	150	150	150	150	150	150
41-80	220	220	220	220	220	150	150	150	150	150	150	150	150	150
11-40	220	220	220	220	220	220	220	220	220	220	150	150	150	150
1-10	220	220	220	220	220	220	220	220	220	220	220	220	220	220

Table 3 — Approx. Oil Capacity in Quart ■

Reducer Size TXT SCXT HXT	Reducer Positions					
	Horizontal				Vertical	
	A	B	C	D	E	F
109, 115, 125	1/2	1/2	5/8	3/4	1	1 1/4
105	5/8	3/4	5/8	3/4	1 1/8	1 3/8
209, 215, 225	7/8	1	5/8	1	1 5/8	1 3/4
205	3/4	7/8	7/8	7/8	1 3/4	2 1/4
309, 315, 325	1 1/2	1 1/2	3/4	2 1/4	2 5/8	3
305	7/8	1 1/2	1 3/8	1 3/8	2 1/2	3 1/8
409, 415, 425	1 7/8	2 1/4	1 1/4	1 3/4	3 3/8	4 1/4
405	1 1/2	2 1/4	2 1/8	1 7/8	4	4 7/8
509, 515, 525	3 1/4	4	3 1/4	4	7	8 5/8
505	3 3/8	4 1/4	3 7/8	3 3/4	7 3/4	9
609, 615, 625	4 1/4	5	4 1/4	5	8 5/8	9 1/8
605	4 1/2	5 3/4	4 1/2	5	12	11
709, 715, 725	6 1/2	8	7 1/4	9 1/4	15 3/8	16 3/8
705	7 1/2	9	7 1/2	9 1/4	19	17 1/4
815, 825	8 1/2	11	10 1/2	8 1/2	19 1/8	19 1/8
805	6	15	10	8 1/2	22	18 3/4
915, 926	13	13	12 1/2	14 1/4	25 3/8	25 3/8
905	14 3/4	15	16 1/4	13 3/4	31 7/8	31 7/8
1015, 1024	23	14	15 3/4	18 3/4	41	41
1215, 1225	59	38	59	36 1/2	100	100
TDT1325	86	62	86	59	110	110
TDT1425	120	88	120	61	150	150
TDT1530	197	138	192	170	281	281

■ U.S. Measure: 1 qt. = 32 fluid oz.

Lubricant Grade Equivalents

ISO	AGMA
150	4
220	5
320	6

NOTE: Mobil SHC 630 Series oil is recommended for high ambient temperatures.

*** NOTES:**

1. Assumes auxiliary cooling where recommended in the catalog.
2. Pour point of lubricant selected should be at least 10°F lower than expected minimum ambient starting temperature.
3. Extreme pressure (EP) lubricants are not recommended for average operating conditions.
4. Special lubricants may be required for food and drug industry applications where contact with the product being manufactured may occur. Consult a lubrication manufacturer's representative for his recommendations.
5. Do not use oils containing EP additives such as graphite or molybdenum disulphide in the reducer when backstop is used. These additives will destroy sprag action.
6. For reducers operating in ambient temperatures between –22°F (–30°C) and 20°F (6.6°C), use a synthetic hycrocarbon lubricant, 100 ISO grade or AGMA 35 grade (for example, Mobil SHC627). Above 125°F (51.6°C), consult DODGE Gear Application Engineering at (803) 288-9050 for lubrication recommendation.

APPENDIX G

Installation and Parts Replacement Manual for DODGE Torque-Arm™ TXT Double Reduction Taper Bushed and Straight Bore Speed Reducers

TXT/HXT 1A	TXT/HXT 5C	TXT 8A
TXT/HXT 2A	TXT/HXT 6A	TXT 9A
TXT/HXT 3B	TXT/HXT 7A	TXT 10A
TXT/HXT 4B		

Includes Char-Lynn 6B Hydroil Reducers

HXT 3B – 6B	HXT 5C – 6B	HXT 7A – 6B
HXT 4B – 6B	HXT 6A – 6B	

These instructions must be read thoroughly before installation or operation.

INSTALLATION:

1. Use lifting bracket where applicable to lift reducer.
2. Determine the running positions of the reducer. (See Fig. 1)

   Note that the reducer is supplied with six plugs; four around the sides for horizontal installations and one on each face for vertical installations. These plugs must be arranged relative to the running positions as follows:

   Horizontal Installations - Install the magnetic drain plug in the hole closest to the bottom of the reducer. Install the filter/ventilation plug in topmost hole. Of the two remaining plugs on the sides of the reducer, the lowest plug is the minimum oil level plug.

   Vertical Installations - Install the filter/ventilation plug in the hole provided in the upper face of the reducer housing. If space is restricted on the upper face, install the vent in the highest hole on the side of the reducer per Figure 1 using the optional vertical vent kit. Install a plug in the hole in the bottom face of the reducer. Do not use this hole for the magnetic drain plug. Install the magnetic drain plug in the lowest hole on the sides of the reducer. Of the remaining holes on the sides of the reducer, use the plug in the upper housing half for the minimum oil level plug,

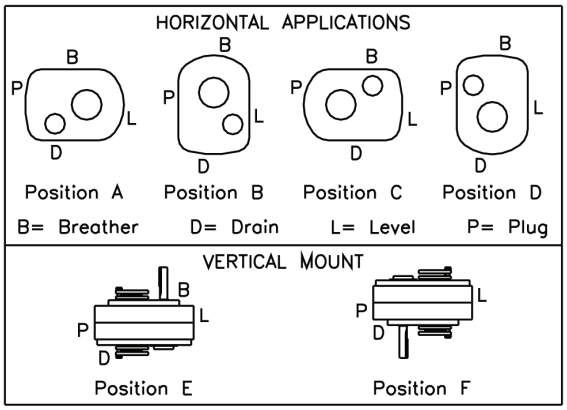


Figure 1 - Mounting Positions

WARNING Because of the possible danger to persons(s) or property from accidents which may result from the improper use of products, it is important that correct procedures be followed. Products must be used in accordance with the engineering information specified in the catalog. Proper installation, maintenance and operation procedures must be observed. The instructions in the instruction manuals must be followed. Inspections should be made as necessary to assure safe operation under prevailing conditions. Proper guards and other suitable safety devices or procedures as may be desirable or as may be specified in safety codes should be provided, and are neither provided by Baldor Electric Company nor are the responsibility of Baldor Electric Company. This unit and its associated equipment must be installed, adjusted and maintained by qualified personnel who are familiar with the construction and operation of all equipment in the system and the potential hazards involved. When risk to persons or property may be involved, a holding device must be an integral part of the driven equipment beyond the speed reducer output shaft.

Below 15 RPM output speed, oil level must be adjusted to reach the highest oil level plug. If reducer position is to vary from those shown in Figure 1, either more or less oil may be required. Consult Dodge.

The running position of the reducer in a horizontal application is not limited to the four positions shown in Fig. 1. However, if running position is over 20° in position "B" & "D" or 5° in position "A" & "C", either way from sketches, the oil level plug cannot be used safely to check the oil level, unless during the checking, the torque arm is disconnected and the reducer is swung to within 20° for position "B" & "D" or 5° for position "A" & "C" of the positions shown in Fig. 1. Because of the many possible positions of the reducer, it may be necessary or desirable to make special adaptations using the lubrication filling holes furnished along with other standard pipe fittings, stand pipes and oil level gauges as required.

3. Mount reducer on driven shaft as follows:

WARNING: To ensure that drive is not unexpectedly started, turn off and lock out or tag power source before proceeding. Remove all external loads from drive before removing or servicing drive or accessories. Failure to observe these precautions could result in bodily injury.

For Taper Bushed Reducer: Mount the reducer on the driven shaft per instruction sheet for the tapered bushing kit.

4. Install sheave on input shaft as close to reducer as practical. (See Fig. 2)
5. If not using a Dodge Torque-Arm motor mount, install motor and V-belt drive so belt will approximately be at right angles to the centerline between driven and input shaft. (See Fig. 3) This will permit tightening the V-belt with the torque arm.
6. Install torque arm and adapter plates using the long reducer bolts. The adapter plates may be installed in any position around the input end of the reducer.
7. Install torque arm fulcrum on a flat and rigid support so that the torque arm will be approximately at right angles to the centerline through the driven shaft and the torque arm anchor screw. (See Fig. 4) Make sure that there is sufficient take-up in the turnbuckle for belt tension adjustment when using V-belt drive.

CAUTION: Unit is shipped without oil. Add proper amount of recommended lubricant before operating. Failure to observe this precaution could result in damage to or destruction of the equipment.

8. Fill gear reducer with the recommended volume of lubricant.

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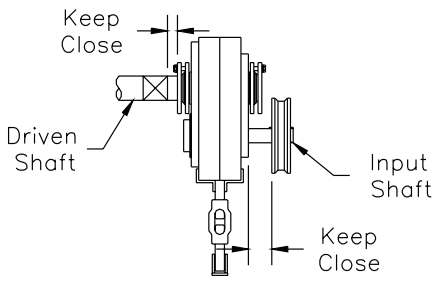


Figure 2 - Reducer and Sheave Installation

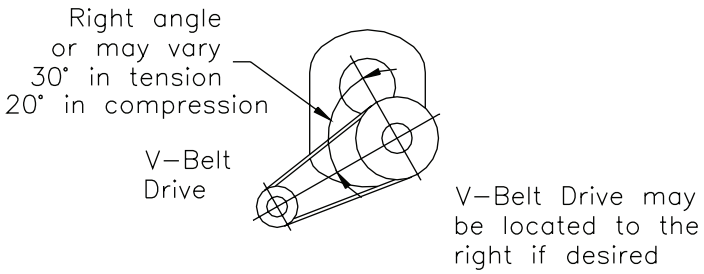


Figure 3 - Angle of V-Drive

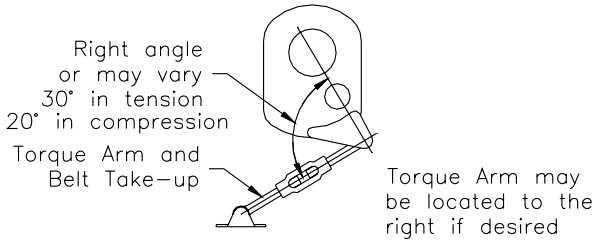


Figure 4 - Angle of Torque Arm

TXT TAPERED BUSHING INSTALLATION

WARNING: To ensure that drive is not unexpectedly started, turn off and lock out or tag power source before proceeding. Remove all external loads from drive before removing or servicing drive or accessories. Failure to observe these precautions could result in bodily injury.

Taper Bore Bushings:

1. One bushing assembly is required to mount the reducer on the driven shaft. An assembly consists of two tapered bushings, bushing screws and washers, and necessary shaft keys or key.

   The driven shaft must extend through the full length of the reducer. The minimum shaft length, as measured from the end of the shaft to the outer edge of the bushing flange (see Figure 5), is given in Table 1. This dimension does not include dimension “A”. Dimension “A” should be added to the minimum shaft length to allow for the removal of the bushings at disassembly.
2. Place one bushing, flange end first, onto the driven shaft and position per dimension “A”, as shown in Table 1. This will allow the bolts to be threaded into the bushing and for future bushing and reducer removal. If the reducer must be positioned closer to the equipment than dimension “A”, place the screws, with washers installed, into the unthreaded holes of the bushing flange prior to placing the bushing on the shaft and position as required.
3. Insert the output key in the shaft and bushing. For ease of installation, rotate the driven shaft so that the shaft keyseat is at the top position.
4. Mount the reducer on the driven shaft and align the shaft key with the reducer hub keyway. Maintain the recommended minimum distance “A” from the shaft bearing.
5. Insert the screws, with washers installed, in the unthreaded holes in the bushing flange and align with the threaded holes in the bushing backup plate. If necessary, rotate the bushing backup plate to align with the bushing screws. Tighten the screws lightly. If the reducer must be positioned closer than dimension “A”, place the screws with washers installed, in the unthreaded holes in the bushing before positioning reducer making sure to maintain at least 1/8” between the screw heads and the bearing.
6. Place the second tapered bushing in position on the shaft and align the bushing keyway with the shaft key. Align the unthreaded holes in the bushing with the threaded holes in the bushing backup plate. If necessary, rotate the bushing backup plate to align with the bushing holes. Insert bushing screws, with washers installed in the unthreaded holes in the bushing. Tighten screws lightly.
7. Alternately and evenly tighten the screws in the bushing nearest the equipment to the recommended torque given in Table 1. Repeat procedure on outer bushing.

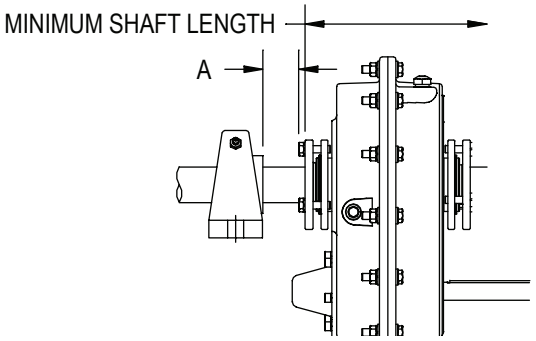


Figure 5 - Minimum Recommended Dimensions

Table 1 - Minimum Mounting Dimensions and Bolt Torques

Minimum Required Shaft Length		
Reducer Size	**Taper Bushing**	**Straight Bushing**
TXT1A	6-1/2	5-5/8
TXT2A	6-3/4	5-13/16
TXT3B	8-9/16	7-11/16
TXT4B	9-5/16	8-1/4
TXT5C	9-3/4	8-11/16
TXT6A	10-3/4	9-5/8
TXT7A	11-15/16	10-3/4
TXT8A	13-1/8	11-3/8
TXT9A	13-0	11-3/8
TXT10A	14-3/16	12-3/8

Bushing Screw Information and Minimum Clearance for Removal			
Reducer Size	**Fastener Size**	**Torque in In.-Lbs.**	**Dim. “A”**
TXT1A	5/16-18	200	1-1/4
TXT2A	5/16-18	200	1-1/4
TXT3B	3/8-16	200	1-1/2
TXT4B	3/8-16	360	1-3/4
TXT5C	3/8-16	360	1-13/16
TXT6A	1/2-13	360	1-13/16
TXT7A	1/2-13	800	2-1/16
TXT8A	1/2-13	800	2-1/16
TXT9A	1/2-13	900	2-7/16
TXT10A	5/8-11	900	2-7/16

Straight Bore Bushings:

1. One bushing assembly is required to mount the reducer on the driven shaft. An assembly consists of one keyed straight bushing, one plain straight bushing, required set screws, and necessary shaft key or keys. The driven shaft must extent through the reducer to operate properly. The minimum shaft length, as measured from the end of the shaft to the outer edge of the retaining collar, is given in Table 1.
2. Install the plain bushing into the reducer output hub on the side toward the equipment or bearing. Remove two short set screws from the retaining collar and install two of the longer set screws supplied with the bushing kit. Line up the bushing holes with the set screws. Thread the set screws in until they locate into the bushing holes. Make sure the set screws are threaded in only enough to locate the bushing in the reducer hub and does not extend thru the bushing.
3. Install the keyed bushing into the opposite end of the reducer hub as the plain bushing. Remove one short set screw from the retaining collar and install the remaining set screw from the bushing kit into the collar. Line up the bushing hole with the set screw. Thread the set screw in until it locates into the bushing hole. Make sure the set screw is threaded in only enough to locate the bushing in the reducer hub and does not extend through the bushing.
4. Mount the reducer on the driven shaft as close to the equipment or bearing as practical.
5. Line up the keyway in the bushing with the keyway in the driven shaft. Insert the key supplied with the bushing kit into the keyway. Gently tap the key into position until the key is flush with the edge of the reducer. Securely tighten all set screws.

Standard Tapered Bushings Removal:

1. Remove bushing screws.
2. Place the screws in the threaded holes provided in the bushing flanges. Tighten the screws alternately and evenly until the bushings are free on the shaft. For ease of tightening screws make sure screw threads and threaded holes in the bushing flanges are clean. If the reducer was positioned closer than the recommended minimum distance "A" as shown in Table 1, loosen the inboard bushing screws until they are clear of the bushing flange by 1/8". Locate two (2) wedges at 180 degrees between the bushing flange and the bushing backup plate. Drive the wedges alternately and evenly until the bushing is free on the shaft.
3. Remove the outside bushing, the reducer, key(s), and inboard bushing.

LUBRICATION

IMPORTANT: Because Torque-Arm reducers are shipped without oil, it is extremely important to add the proper amount of lubricant prior to operating reducer. For most applications a high-grade petroleum-base rust and oxidation inhibited (R&O) gear oil is suitable. See Table 2 and Table 3 for proper oil volume and viscosity requirements.

Under severe conditions EP oil can be used provided the reducer is not equipped with an internal backstop. Internal backstops are designed to rely on friction to operate correctly. EP lubricants contain friction modifiers that will alter backstop performance and therefore must not to be used on reducers equipped with internal backstops.

Follow instructions on reducer warning tags.

Lubrication is very important for satisfactory operation. The proper oil level must be maintained at all times. Frequent inspection, at least monthly, with the unit not running and allowing sufficient time for the oil to cool and the entrapped air to settle out of the oil should be made by removing the level plug and verifying the level is being maintained. If oil level is low, add the proper lubricant until the oil volume is increased to the correct level.
After an initial operation of about two weeks, the oil should be changed. If desired, this oil may be filtered and reused. After the initial break in period, under average industrial operating conditions, the lubricant should be changed every 2500 hours of operation. At every oil change, drain reducer and flush with kerosene, clean magnetic drain plug and refill to proper level with new lubricant.

Under extreme operating conditions, such as rapid rise and fall of temperature, dust, dirt, chemical particles, chemical fumes, or oil sump temperatures above 200°F, the oil should be changed every 1 to 3 months, depending on severity of conditions.

CAUTION: Too much oil will cause overheating and too little will result in gear failure. Check oil level regularly. Failure to observe this precaution could result in equipment damage and/or bodily injury.

Heating is a natural characteristic of enclosed gearing. A maximum gear case temperature approaching 200°F is not uncommon for some units operating in normal ambient temperatures of 80°F. When operating at the rated capacity with proper lubrication, no damage will result from this temperature. This maximum temperature was taken into consideration during the design of the reducer.

Table 2 - Oil Volumes

Reducer		Approximate Volume of Oil to Fill Reducer to Oil Level Plug ① ⑤ ⑥											
		② Position A		② Position B		② Position C		② Position D		② Position E		② Position F	
Size	Ratio	③ Qt	④ L	③ Qt	④ L	③ Qt	④ L	③ Qt	④ L	③ Qt	④ L	Qt	L
TXT1A	9,15,25	1/2	1/2	1/2	1/2	5/8	5/8	3/4	3/4	1	1	1-1/4	1-1/8
TXT2A	9,15,25	7/8	7/8	1	1	5/8	5/8	1	1	1-5/8	1-1/2	1-3/4	1-5/8
TXT3B	9,15,25	1-1/2	1-3/8	1-1/2	1-3/8	3/4	3/4	2-1/4	2-1/8	2-5/8	2-1/2	3	2-7/8
TXT4B	9,15,25	1-7/8	1-3/4	2-1/4	2-1/8	1-1/4	1-1/8	1-3/4	1-5/8	3-3/8	3-1/8	4-1/4	4
TXT5C	9,15,25	3-1/4	3-1/8	4	3-3/4	3-1/4	3-1/8	4	3-3/4	7	6-5/8	8-5/8	8-1/8
TXT6A	9,15,25	4-1/4	4	5	4-3/4	4-1/4	4	5	4-3/4	8-5/8	8-1/8	9-1/8	8-5/8
TXT7A	9,15,25	6-1/2	6-1/8	8	7-1/2	7-1/4	6-7/8	9-1/4	8-3/4	15-3/8	14-1/2	16-3/8	15-1/2
TXT8A	15,25	8-1/2	8	11	10-3/8	10-1/2	9-7/8	8-1/2	8	19-1/8	18-1/8	19-1/8	18-1/8
TXT9A	15,26	13	12-1/4	13	12-1/4	12-1/2	11-7/8	14-1/4	13-1/2	25-3/8	24	25-3/8	24
TXT10A	15,24	23	21-3/4	14	13-1/4	15-3/4	14-7/8	18-3/4	17-3/4	41	38-3/4	41	38-3/4

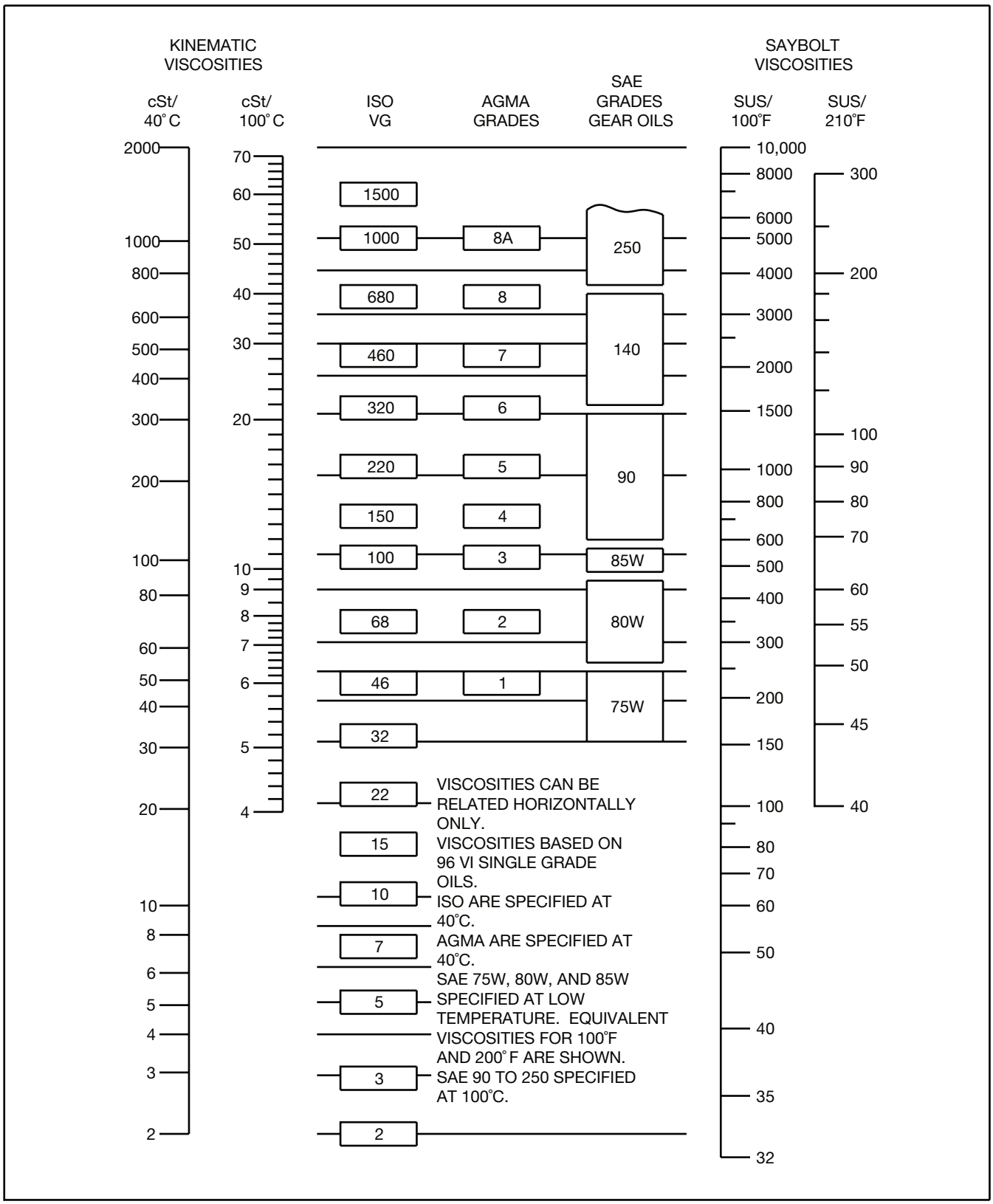
① Oil quantity is approximate. Service with lubricant until oil runs out of oil level hole.
② Refer to Figure 1 for mounting positions.
③ US measure: 1 quart = 32 fluid ounces = .94646 liters.
④ Conversion from quarts rounded values.
⑤ Below 15 RPM output speed, oil level must be adjusted to reach the highest oil level plug. If reducer position is to vary from those shown in Figure 1, either more or less oil may be required. Consult Dodge.
⑥ Consult Dodge for proper oil level for reducers equipped with backstops and which are mounted in either the C position or D position.

Table 3 - Oil Recommendations										
ISO Grades For Ambient Temperatures of 50°F to 125°F (Refer to Notes below)										
Output RPM	Torque-Arm Reducer Size									
	TXT1A	TXT2A	TXT3B	TXT4B	TXT5C	TXT6A	TXT7A	TXT8A	TXT9A	TXT10A
301 – 400	320	320	220	220	220	220	220	220	220	220
201 – 300	320	320	220	220	220	220	220	220	220	220
151 – 200	320	320	220	220	220	220	220	220	220	220
126 – 150	320	320	320	220	220	220	220	220	220	220
101 – 125	320	320	320	320	220	220	220	220	220	220
81 – 100	320	320	320	320	320	220	220	220	220	220
41 – 80	320	320	320	320	320	220	220	220	220	220
11 – 40	320	320	320	320	320	320	320	320	320	320
1 – 10	320	320	320	320	320	320	320	320	320	320

ISO Grades For Ambient Temperatures of 15°F to 60°F (Refer to Notes below)										
Output RPM	Torque-Arm Reducer Size									
	TXT1A	TXT2A	TXT3B	TXT4B	TXT5C	TXT6A	TXT7A	TXT8A	TXT9A	TXT10A
301 – 400	220	220	150	150	150	150	150	150	150	150
201 – 300	220	220	150	150	150	150	150	150	150	150
151 – 200	220	220	150	150	150	150	150	150	150	150
126 – 150	220	220	220	150	150	150	150	150	150	150
101 – 125	220	220	220	220	150	150	150	150	150	150
81 – 100	220	220	220	220	220	150	150	150	150	150
41 – 80	220	220	220	220	220	150	150	150	150	150
11 – 40	220	220	220	220	220	220	220	220	220	220
1 – 10	220	220	220	220	220	220	220	220	220	220

Notes:
1. Assumes auxiliary cooling where recommended in the catalog.
2. Pour point of lubricant selected should be at least 10°F lower than expected minimum ambient starting temperature.
3. Extreme pressure (EP) lubricants are not necessary for average operating conditions. TORQUE-ARM internal backstops are not suitable for use with EP lubricants.
4. Special lubricants may be required for food and drug industry applications where contact with the product being manufactured may occur. Consult a lubrication manufacturer's representative for his recommendations .
5. For reducers operating in ambient temperatures between -22°F (-30°C) and 20°F (–6.6°C) use a synthetic hydrocarbon lubricant, 100 ISO grade or AGMA 3 grade (for example, Mobil SHC627) . Above 125°F (51°C), consult DODGE Gear Application Engineering (864) 284-5700 for lubrication recommendation .
6. Mobil SHC630 Series oil is recommended for high ambient temperatures.

OIL VISCOSITY EQUIVALENCY CHART



GUIDELINES FOR TXT REDUCER LONG-TERM STORAGE

During periods of long storage, or when waiting for delivery or installation of other equipment, special care should be taken to protect a gear reducer to have it ready to be in the best condition when placed into service.

By taking special precautions, problems such as seal leakage and reducer failure due to lack of lubrication, improper lubrication quantity, or contamination can be avoided. The following precautions will protect gear reducers during periods of extended storage:

Preparation:

1. Drain oil from the unit. Add a vapor phase corrosion inhibiting oil (VCI-105 oil by Daubert Chemical Co.) in accordance with Table 4.
2. Seal the unit airtight. Replace the vent plug with a standard pipe plug and wire the vent to the unit.
3. Cover all unpainted exterior parts with a waxy rust preventative compound that will keep oxygen away from the bare metal. (Non-Rust X-110 by Daubert Chemical Co. or equivalent)
4. The instruction manuals and lubrication tags are paper and must be kept dry. Either remove these documents and store them inside, or cover the unit with a durable waterproof cover which can keep moisture away.
5. Protect reducer from dust, moisture, and other contaminants by storing the unit in a dry area.
6. In damp environments, the reducer should be packed inside a moisture-proof container or an envelope of polyethylene containing a desiccant material. If the reducer is to be stored outdoors, cover the entire exterior with a rust preventative.

When placing the reducer into service:

1. Fill the unit to the proper oil level using a recommended lubricant. The VCI oil will not affect the new lubricant.
2. Clean the shaft extensions with petroleum solvents.
3. Assemble the vent plug into the proper hole.

Follow the installation instructions provided in this manual.

Table 4 - Quantities of VCI #105 Oil

Reducer Size	Quantity (Ounces / Mililiter)
TXT1A	1 / 30
TXT2A	1 / 30
TXT3B	1 / 30
TXT4B	1 / 30
TXT5C	1 / 30
TXT6A	2 / 59
TXT7A	2 / 59
TXT8A	3 / 89
TXT9A	4 / 118
TXT10A	6 / 177

VCI #105 and #10 are interchangeable.
VCI #105 is more readily available.

Motor Mounts

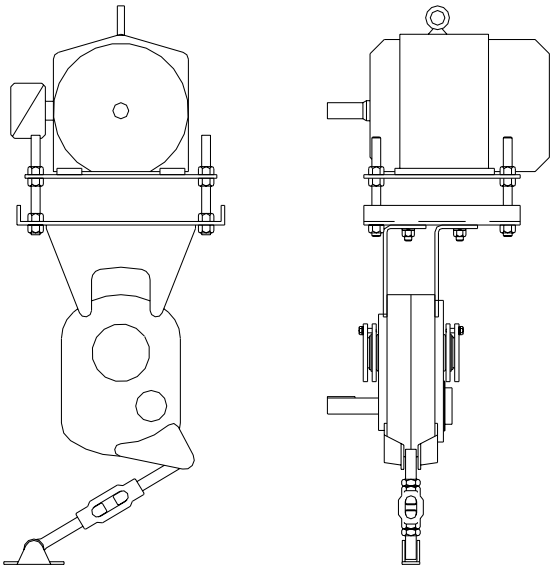


Figure 6 - Motor Mounts

Warning: Belt guard removed for illustration purposes. Do not operate if belt guard is not in place.

Motor Mount Installation:

The TA motor mount is designed to be installed on the output end of the reducer as shown in Figure 6. If bottom mounting is desired, use the optional TAB style.

TA1M thru TA7M Motor Mount:

Remove the required housing bolts on the output end of the reducer. Place the motor mount brackets in position and install the longer housing bolts supplied with the motor mount assembly. Do not fully tighten the housing bolts at this time.

Install the bottom plate to the motor mount brackets and tighten with the hardware provided. Next, tighten the housing bolts to the torque values listed in Table 6.

Install the four adjusting studs to the bottom plate using the jam nuts provided and securely tighten. These nuts will not require any further adjustment. Add one additional jam nut to each stud and thread approximately to the middle of the stud. Install the top motor plate on top of the jam nuts. Assemble the remaining jam nuts on studs to secure top motor plate. Do not fully tighten these nuts yet.

Mount motor, drive and driven sheaves, and v-belts.

Note: Mount driven sheave as close to the reducer housing as practical.

Adjust v-belts to the proper tension by adjusting the jam nuts and securely tighten.

Check all bolts to insure that they are securely tightened.

TA8 thru TA10 Motor Mount:

Remove the required housing bolts on the output end of the reducer. Place the motor mount brackets in position and install the longer housing bolts supplied with the motor mount assembly. Do not fully tighten the housing bolts at this time.

Install the four adjusting studs to the top plate as shown using the jam nuts provided and securely tighten. Add one additional

jam nut to each stud and thread approximately to the middle of the stud. Install this assembly to the motor mount brackets and install the remaining jam nuts onto the studs to secure the top plate to the brackets. Tighten the housing bolts to the torque values listed in Table 6.

Loosely install the front motor rail to the top plate. Measure the distance between the front and rear mounting holes on the motor and position the rear motor rail at this distance and loosely bolt to the top plate.

Center the motor on the motor rails and securely bolt the motor to the motor rails.

Install the motor sheave and reducer sheave on their shafts. Mount the reducer sheave as close to the housings as practical. Install the v-belts and adjust the motor rails to permit proper alignment of the v-belts to the sheaves. Securely tighten the motor rails to the mounting plate.

Adjust the v-belts to the proper tension and securely tighten the adjusting nuts.

Check all bolts to see that they are securely tightened.

WARNING: To ensure that drive is not unexpectedly started, turn off and lock out or tag power source before proceeding. Remove all external loads from drive before removing or servicing drive or accessories. Failure to observe these precautions could result in bodily injury.

REPLACEMENT OF PARTS

NOTE: Using tools normally found in a maintenance department, a Dodge Torque-Arm speed reducer can be disassembled and reassembled by careful attention to the instructions following.

Cleanliness is very important to prevent the introduction of dirt into the bearings and other parts of the reducer. A tank of clean solvent, an arbor press, and equipment for heating bearings and gears (for shrinking these parts on shafts) should be available.

The oil seals are designed with a contact lip. Considerable care should be used during disassembly and reassembly to avoid damage to the surface on which the seals rub.

The keyseat in the input shaft, as well as any sharp edges on the output hub should be covered with tape or paper before disassembly or reassembly. Also, be careful to remove any burrs or nicks on surfaces of the input shaft or output hub before disassembly or reassembly.

Ordering Parts:

When ordering parts for a Dodge Torque Arm reducer, specify reducer part number, part name, and quantity required.

It is strongly recommended that, when a pinion or gear is replaced, the mating pinion or gear is replaced also.

If the large gear on the output hub must be replaced, it is recommended that an output hub assembly consisting of a gear assembled on a hub be ordered to ensure undamaged surfaces on the output hub where the output seals rub. However, if it is desired to use the old output hub, press the gear and bearing off and examine the rubbing surface under the oil seal carefully for possible scratching or other damage resulting from the pressing operation. To prevent oil leakage at the shaft oil seals, the smooth surface of the output hub must not be damaged.

If any parts must be pressed from a shaft or from the output hub, this should be done before ordering parts to make sure that none of the bearings or other parts are damaged in removal. Do not press against rollers or cage of any bearing.
Because old shaft oil seals may be damaged in disassembly, it is advisable to order replacements for these parts.

Removing Reducer from Shaft:

WARNING: To ensure that drive is not unexpectedly started, turn off and lock out or tag power source before proceeding. Remove all external loads from drive before removing or servicing drive or accessories. Failure to observe these precautions could result in bodily injury.

Taper Bushed Reducer:

1. Disconnect and remove belt guard, v-drive, and motor mount as required. Disconnect torque arm rod from reducer adapter.
2. Remove bushing screws.
3. Place the screws in the threaded holes provided in the bushing flanges. Tighten the screws alternately and evenly until the bushings are free on the shaft. For ease of tightening screws, make sure screw threads and threaded holes in bushing flanges are clean. A tap can be used to clean out the threads. Use caution to use the proper size tap to prevent damage to the threads.
4. Remove the outside bushing, the reducer, and then the inboard bushing.

Straight Bore Reducer:

1. Disconnect and remove belt guard, v-drive, and motor mount as required. Disconnect torque arm rod from reducer adapter.
2. Loosen and remove the set screws in both output hub collars.
3. Remove the collar from the output hub closest to the end of the shaft. This will expose three puller holes in the output hub to permit the use of a three prong puller. In removing the reducer from the shaft, use care not to damage the reducer output hub.

Disassembly:

1. Drain all oil from the reducer.
2. Remove all locking collars, retaining rings, and bushing backup plated as required. Position the reducer on its side and remove all housing bolts. Using the three pry slots around the periphery of the flange, gently separate the housing halves and open evenly to prevent damage to the parts inside. Remove the two dowel pins.
3. Lift input shaft, all gear assemblies, and bearing assemblies from housing.
4. Remove seals from housing.
5. Remove bearings from shafts and hubs. Be careful not to scratch or damage any assembly or seal area during bearing removal. The hub assembly can be disassembled for gear replacement but if scratching or grooving occurs on the hub, seal leakage will occur and the hub will need to be replaced.

TXT Reassembly:

1. Output Hub Assembly: Heat gear to 325°F to 350°F to shrink onto hub. Heat bearings to 270°F to 290°F to shrink onto hub. Any damage to the hub surfaces where the oil seals rub will cause leakage, making it necessary to replace the hub.
2. Countershaft Assembly: Heat gear to 325°F to 350°F and bearings to 270°F to 290°F to shrink onto shaft.
3. Input Shaft Assembly: Heat bearings 270°F to 290°F to shrink onto shaft. Press bearings on shaft.
4. Drive the two dowel pins into place in the right-hand housing half (backstop side).
5. Place R.H. housing half on blocks to allow for protruding end of output hub.
6. Install all bearing cups on TXT3B thru TXT10A in right-hand housing half, making sure they are properly seated. TXT1A and TXT2A reducers use ball bearings on all shafts and do not incorporate bearing cups.
7. Mesh output hub gear and small countershaft gear together and set in place in housing. Set input shaft assembly in

place in the housing. Make sure bearing rollers (cones) are properly seated in their cups.

8. Make sure both housing halves are clean. Apply a continuous 1/8" diameter bead of Dow Corning RTV732 sealant on the flange surface of the R.H. housing (make sure RTV is placed around all bolt holes). Set the left-hand housing half into position onto the dowel pins and gently tap with a soft hammer (rawhide, not lead hammer) until housing bolts can be used to draw housing halves together. Make sure reducer shafts do not bind while tightening housing bolts. Torque housing bolts per torque values listed in Table 6.
9. On TXT1A and TXT2A reducers, skip to step number 12.
10. Place the output bearing cup into the housing and tap into place. Install the output seal carrier and draw down with two bolts 180° apart to 50 inch pounds of torque. Loosen both bolts then retighten finger tight only. Measure the clearance between the housing and carrier flange at each bolt and average the two values. Add 0.010" to the average reading and make up shim pack. Install shim pack between the carrier flange and the reducer housing. Torque the bolts to the value shown in Table 6. Using a magnetic base and dial indicator, check the axial end play. Add or remove shims until the axial endplay reading of the output hub is per Table 5.
11. Repeat step 9 above for installing and adjusting the countershaft and input bearings. Adjust the axial endplay per Table 5.
12. Install input and output seals. Lightly coat the seal lips with Mobilith AW2 All-Purpose grease or equivalent. The possibility of damage and consequent oil leakage can be decreased by covering all sharp edges with tape prior to seal installation. Seals should be pressed or tapped with a soft hammer evenly into place in the reducer housing, applying pressure only on the outer edge of the seals. Extreme care should be used when installing seals to avoid damage due to contact with sharp edges on the input shaft or output hub. A slight oil leak at the seals may be evident during initial running, but should disappear unless seals have been damaged.
13. Install bushing backup plates and snap rings on Taper Bushed reducers or hub collars on straight bore reducers and install backstop cover. Make sure all bolts are tightened to the correct torque values listed in Table 6.

Table 5 - Bearing Adjustment Tolerances

Reducer Size	Bearing Endplay Values		
	Input	Countershaft	Ouput
TXT1A	N / A	N / A	N / A
TXT2A	N / A	N / A	N / A
TXT3B	.002-.004 Loose	.0005-.003 Loose	.0005-.003 Loose
TXT4B	.002-.004 Loose	.0005-.003 Loose	.0005-.003 Loose
TXT5C	.002-.004 Loose	.0005-.003 Loose	.0005-.003 Loose
TXT6A	.002-.004 Loose	.0005-.003 Loose	.0005-.003 Loose
TXT7A	.002-.004 Loose	.0005-.003 Loose	.0005-.003 Loose
TXT8A	.002-.004 Loose	.0005-.003 Loose	.0005-.003 Loose
TXT9A	.002-.004 Loose	.0005-.003 Loose	.0005-.003 Loose
TXT10A	.002-.004 Loose	.0005-.003 Loose	.0005-.003 Loose

Table 6 - Recommended Bolt Torque Values

Recommended Torque Values (lbs.-ft.)				
Reducer Size	Housing Bolts	Output Seal Carrier	C/S Bearing Cover	Input Seal Carrier
TXT1A	30 - 27	N/A	N/A	N/A
TXT2A	30 - 27	N/A	N/A	N/A
TXT3B	50 - 45	17 – 15	17 – 15	17 – 15
TXT4B	50 - 45	30 – 27	30 – 27	30 – 27
TXT5C	75 - 68	30 – 27	30 – 27	30 – 27
TXT6A	75 - 68	30 – 27	30 – 27	30 – 27
TXT7A	150 - 135	30 – 27	50 - 45	50 - 45
TXT8A	150 - 135	30 – 27	30 – 27	30 – 27
TXT9A	150 - 135	30 – 27	30 – 27	30 – 27
TXT10A	150 - 135	30 – 27	30 – 27	30 – 27

Backstop Cover Bolt Recommended Torque Values

Reducer Size	Fastener Size	Torque in Ft.-Lbs.
TXT1A	10 - 24 x 3/8	5 – 4
TXT2A	10 - 24 x 3/8	5 – 4
TXT3B	10 - 24 x 3/8	5 – 4
TXT4B	¼ - 20 x ½	8 – 7
TXT5C	¼ - 20 x ½	8 – 7
TXT6A	¼ - 20 x ½	8 – 7
TXT7A	¼ - 20 x ½	8 – 7
TXT8A	¼ - 20 x ½	8 – 7
TXT9A	¼ - 20 x ½	8 – 7
TXT10A	¼ - 20 x ½	8 – 7

Replacement Part and Kit Numbers

Table 7 – Part Numbers for Replacement Bearings, Double Reduction Reducers	
Reducer Size	**Output Hub Bearing – LH and RH Sides Part Number**
TXT1A	424020
TXT2A	424022
TXT3B	402272/403127
TXT4B	402268/403163
TXT5C	402193/403016
TXT6A	402050/403140
TXT7A	402058/403111
TXT8A	402147/403105
TXT9A	402160/403110
TXT10A	402168/403116

Reducer Size	Countershaft Bearing – LH Input Side Part Number
TXT1A	424006
TXT2A	424000
TXT3B	402273/403094
TXT4B	402000/403000
TXT5C	402203/403027
TXT6A	402054/403159
TXT7A	402256/403053
TXT8A	402057/403143
TXT9A	402109/403078
TXT10A	402232/402231

Reducer Size	Countershaft Bearing – RH Backstop Side Part Number
TXT1A	424006
TXT2A	424000
TXT3B	402273/403094
TXT4B	402000/403000
TXT5C	402203/403027
TXT6A	402052/403142
TXT7A	402256/403053
TXT8A	402148/403106
TXT9A	402109/403078
TXT10A	402232/402231

Reducer Size	Input Shaft Bearing – LH Input Side Part Number
TXT1A	424112
TXT2A	424019
TXT3B	402204/403139
TXT4B	402280/403027
TXT5C	402144/403104
TXT6A	402196/403091
TXT7A	402150/403106
TXT8A	402098/403072
TXT9A	402114/403080
TXT10A	402114/403080

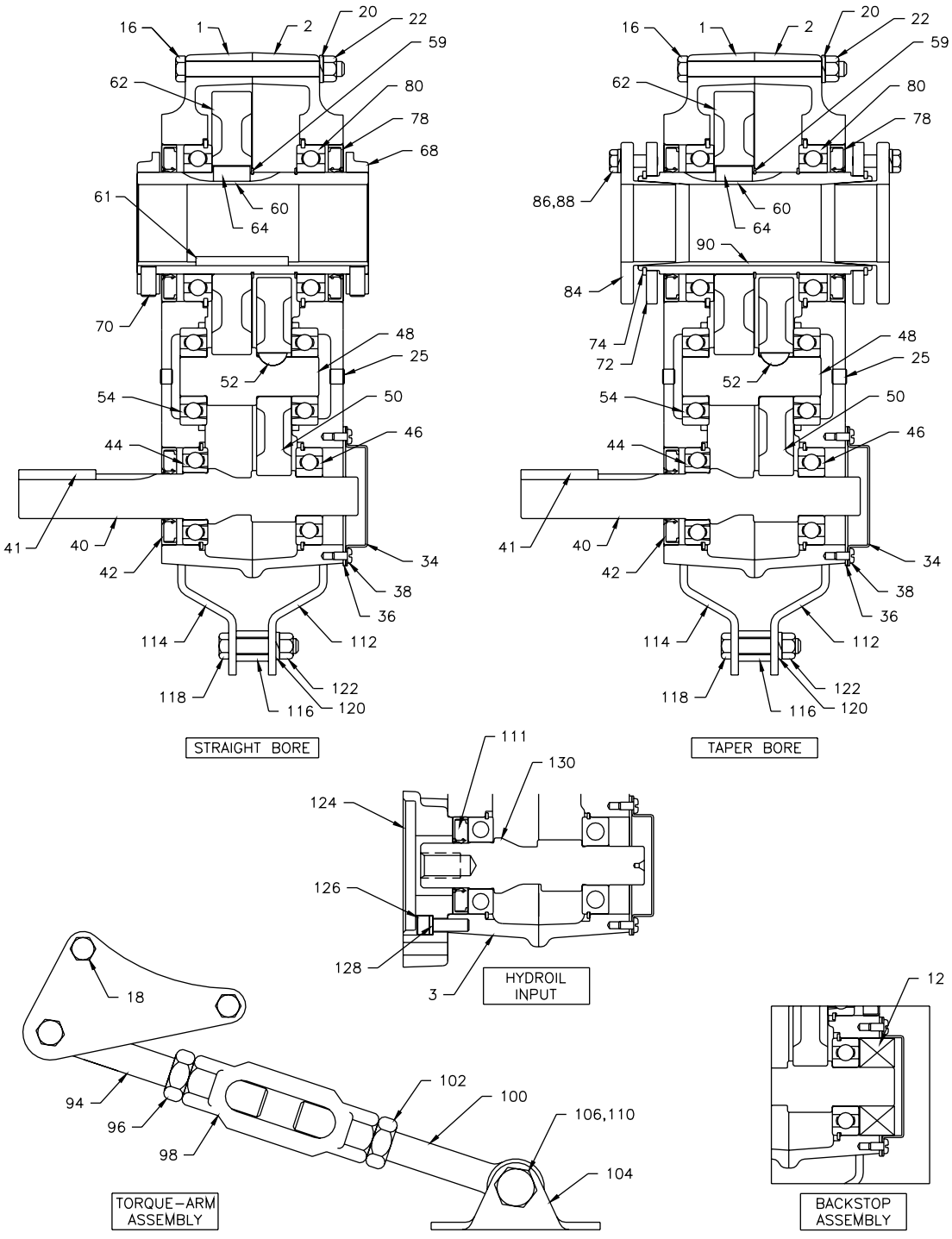
Reducer Size	Input Shaft Bearing – RH Backstop Side Part Number
TXT1A	424111
TXT2A	424090
TXT3B	402273/403094
TXT4B	402142/403102
TXT5C	402266/403073
TXT6A	402197/403091
TXT7A	402088/403047
TXT8A	402097/403072
TXT9A	402107/403076
TXT10A	402112/403080

Note: Bearing part numbers refer to Cup/Cone combinations, respectively, and apply to all ratios unless otherwise specified. For actual reducer ratios, refer to Table 9.

Table 8 - Replacement Parts Kit Numbers						
Reducer Size	Ratio	Seal Kit	Output Hub Assembly		Countershaft Assembly	Bearing Kit(s)
			Taper Hub	Straight Hub		
TXT1A	9:1	392119	390878	390151	392100	389905 All
	15:1				392090	
	25:1				392091	
TXT2A	9:01	392120	392111	392110	392101	389906 All
	15:1				392092	
	25:1				392093	
TXT3B	9:1	389720	389703	389702	389729	392345 All
	15:1				389700	
	25:1				389701	
TXT4B	9:1	389721	389710	389709	389730	392347 All
	15:1				389707	
	25:1				389708	
TXT5C	9:1	389722	389717	389716	389731	392350 All
	15:1				389714	
	25:1				389715	
TXT6A	9:1	246340	390935	390988	392140	335368 All
	15:1				391171	
	25:1				391186	
TXT7A	9:1	247345	390941	390990	392141	392353 All
	15:1				391196	
	25:1				391197	
TXT8A	15:1	248340	390944	390993	391184	392355 All
	25:1				391185	
TXT9A	15:1	249340	390949	390159	390124	392357 All
	26:1				390139	
TXT10A	15:1	272460	390954	390160	390983	392359 All
	24:1				390998	

Notes:
Seal Kit consists of Input Seal, Output Seals, Backstop Cover Gasket and RTV Sealant.
Output Hub Assembly consists of Output Hub, Output Gear and Gear Key.
Countershaft Assembly consists of Countershaft Pinion, Countershaft Gear and Gear Key.
Bearing Kit consists of LH and RH Output Bearing Cup/Cone, LH and RH Countershaft Bearing Cup/Cone (double reduction only) and LH and RH Input Bearing Cup/Cone.

Parts for TXT/HXT 1A & 2A Straight and Tapered Bushed Double Reduction Reducers



Parts for TXT/HXT 1A & 2A Straight and Tapered Bushed Double Reduction Reducers

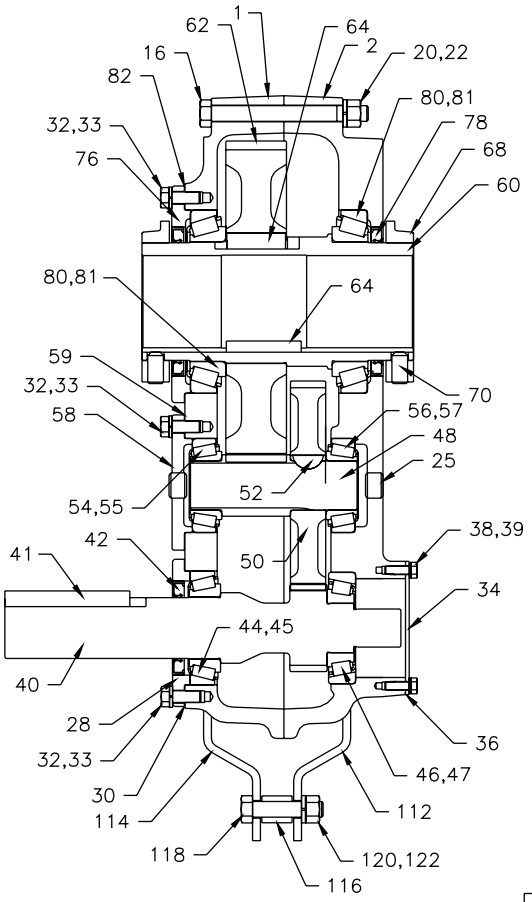
Ref.	Description	Qty.	TXT/HXT 1	TXT/HXT 2
12	Backstop Assembly	1	242101	252101
1	Housing-LH	1	241358	242353
2	Housing-RH	1	241359	242354
	Housing-RH, Flange Mount Drilled	1	241387	242393
3	Housing-Hydroil LH	1	241064	242067
①	RTV Sealant, Tube	1	465044	465044
①	Air Vent	1	900287	900287
16	Housing Bolt	⑦	411418	411418
18	Housing Bolt-Adapter	2	411420	411420
20	Lock-Washer	⑧	419011	419011
22	Hex Nut	⑧	407087	407087
①	Dowel Pin	2	420145	420145
①	Magnetic Oil Plug	1	430060	430060
25	Oil Plug	4	430031	430031
34	Backstop Shaft Cover	1	242221	243221
38	Backstop Cover Screw	4	415022	415022
	Seal Kit ②	1	392119	392120
36	Backstop Cover Gasket ④	1	242220	243220
42	Input Oil Seal ④	1	241457	242211
78	Output Hub Oil Seal ④	2	241210	242210
40	Input Pinion			
	9:1 Ratio ⑥	1	241481	242481
	15:1 Ratio ⑥	1	241302	242186
	25:1 Ratio ⑥	1	241200	242187
130	Hydroil Input Pinion			
	15:1 Ratio ⑥	1	241455	242188
	25:1 Ratio ⑥	1	241449	242189
41	Input Pinion Key	1	443008	443014
	Bearing Replacement Kit ②	1	389905	389906
44	Input Pinion Bearing-LH, Input Side ④	1	424112	424019
46	Input Pinion Bearing-RH, Backstop Side ④	1	424111	424090
54	Countershaft Pinion Bearing ④	2	424006	424000
80	Output Hub Bearings ④	2	424020	424022
	Countershaft Pinion Assembly ②			
	9:1 Ratio ⑥	1	392100	392101
	15:1 Ratio ⑥	1	392090	392092
	25:1 Ratio ⑥	1	392091	392093
48	Countershaft Pinion ④	1	241216	242185
50	First Reduction Gear ④			
	9:1 Ratio ⑥	1	241482	242482
	15:1 Ratio ⑥	1	241170	242008
	25:1 Ratio ⑥	1	241171	242005
52	Countershaft to First Gear Key ④	1	241309	242218
	Taper Bore Output Hub Assembly ②	1	390878	392111
	Straight Bore Output Hub Assembly ③	1	390151	392110
60	Output Hub			
	Straight Bore ⑤	1	241208	242208
	Taper Bore ④	1	241265	242134
62	Output Gear ④ ⑤	1	241007	242181
64	Output Gear Key ④ ⑤	1	241217	443399
59	Output Hub Snap Ring ④	2	421013	421017
61	Straight Bore Output Hub Key ⑤	2	241296	242296
68	Straight Bore Output Hub Collar	2	241209	242209
70	Straight Bore Output Hub Collar Screw	4	400062	400094
72	Taper Bore Bushing Backup Plate	2	241266	242137
74	Bushing Backup Plate Retaining Ring	2	421111	421112
84	Taper Bore Bushing Assembly ②			
	Bushing ④			
	1" Bore	1	241278	N/A
	1-1/16" Bore	1	241280	N/A
	1-1/8" Bore	1	241282	242146
	1-3/16" Bore	1	241286	242148
	1-1/4" Bore	1	241288	242150
	1-5/16" Bore	1	241290	242152
	1-3/8" Bore	1	241294	242154
	1-7/16" Bore	1	241292	242156
	1-11/16" Bore	1	N/A	242164
	1-1/2" Bore	1	N/A	242158
	1-5/8" Bore	1	N/A	242162
	1-3/4" Bore	1	N/A	242166
	1-15/16" Bore	1	N/A	242168

Parts for TXT/HXT 1A & 2A Straight and Tapered Bushed Double Reduction Reducers

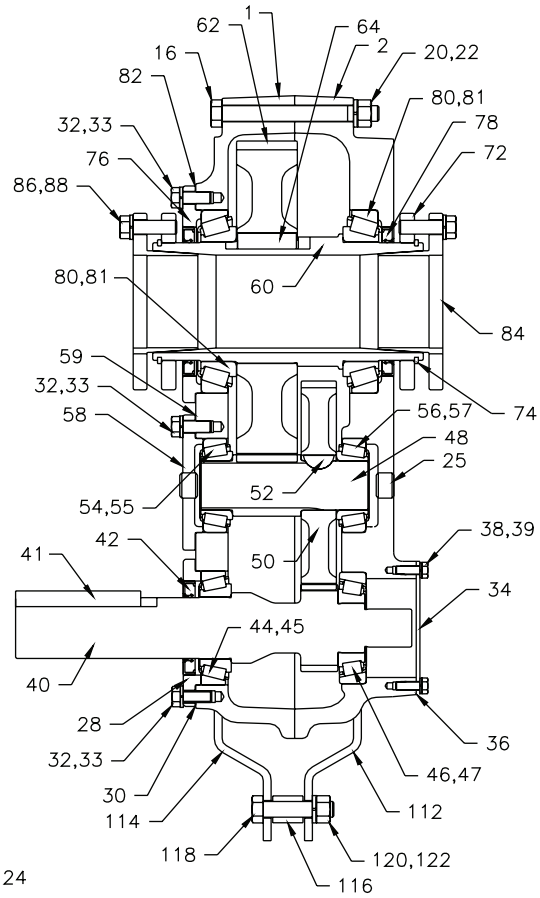
Ref.	Description	Qty.	TXT/HXT 1	TXT/HXT 2
86	Bushing Screw ④	6	411405	411390
88	Lock Washer ④	6	419010	419010
90	Key, Taper Bore Bushing to Shaft ④			
	1" Bore	1	443274	N/A
	1-1/8" Bore	1	443271	443281
	1-3/16" Bore	1	241308	443281
	1-1/4" Bore	1	241307	443281
	1-5/16" Bore	1	241306	443264
	1-3/8" Bore	1	241310	443280
	1-7/16" Bore	1	241305	443282
	1-1/2" Bore	1	N/A	443282
	1-5/8" Bore	1	N/A	424172
	1-11/16"	1	N/A	242171
	1-3/4" Bore	1	N/A	242170
	1-15/16" Bore	1	N/A	443283
①	Key, Bushing to Output Hub ④			
	1" Bore	1	443272	N/A
	1-1/8" Bore	1	443273	N/A
	1-1/8" to 1-1/2" Bore	1	N/A	443284
	Torque-Arm Assembly ②	1	241097	243097
94	Torque-Arm Rod End ④	1	241245	243245
96	RH Nut ④	1	407093	407095
98	Torque-Arm Turnbuckle ④	1	241246	243246
100	Torque-Arm Extension ④	1	241247	243247
102	LH Nut ④	1	407242	407244
104	Torque-Arm Fulcrum ④	1	241249	243249
106	Fulcrum Screw ④	1	411456	411484
110	Hex Nut ④	1	407091	407093
	Adapter Assembly ②	1	259151	259152
112	RH Torque-Arm Adapter Bracket ④	1	241242	242136
114	LH Torque-Arm Adapter Bracket ④	1	241241	242135
116	Adapter Bushing ④	1	242243	243243
118	Adapter Bolt ④	1	411412	411437
120	Lock Washer ④	1	419011	419012
122	Hex Nut ④	1	407087	407089
124	Hydraulic Motor Adapter	1	241454	242454
126	Adapter Screw	6	417081	417081
128	Lockwasher	6	419046	419046
111	Input Pinion Seal, Hydroil	1	241457	242457
①	Motor to Adapter Screw	2	411408	411408
①	Motor to Adapter Lock Washer	2	419011	419011

Notes:
① Not shown on Drawing.
② Includes Parts Listed Immediately Below
③ Includes Parts Listed Immediately Below
④ Makes up Assembly Under Which it is Listed.
⑤ Makes up Assembly Under Which it is Listed.
⑥ See Table 9 for Actual Ratio.
⑦ 4 Required on TXT1A and 5 Required on TXT2A
⑧ 6 Required on TXT1A and 7 Required on TXT2A

Parts for TXT3B thru TXT5C Straight and Tapered Bushed Double Reduction Reducers

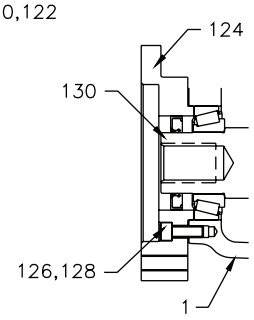


STRAIGHT BORE

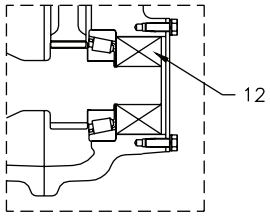


TAPER BORE

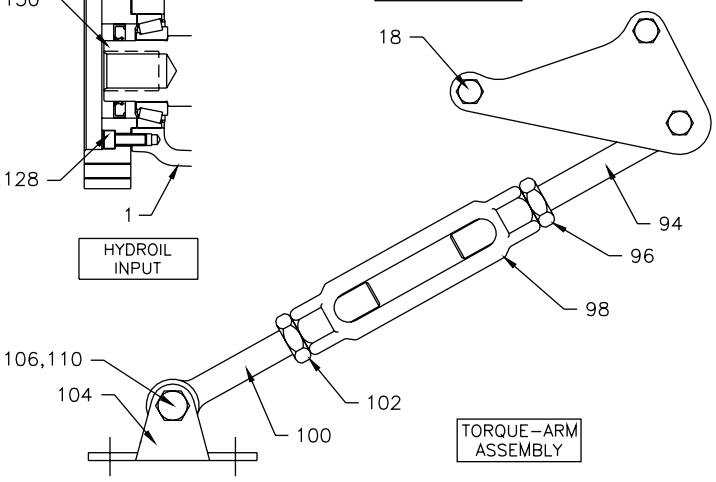
NOTE: THE TWO DIGIT NUMBERS ARE FOR REFERENCE ONLY. ORDER PARTS BY THE SIX DIGIT NUMBER IN THE PARTS LIST. EACH SIX DIGIT NUMBER IS A COMPLETE IDENTIFICATION OF THE PART OR ASSEMBLY.



HYDROIL INPUT



BACKSTOP ASSEMBLY



TORQUE–ARM ASSEMBLY

Parts for TXT3B thru TXT5C Straight and Tapered Bushed Double Reduction Reducer

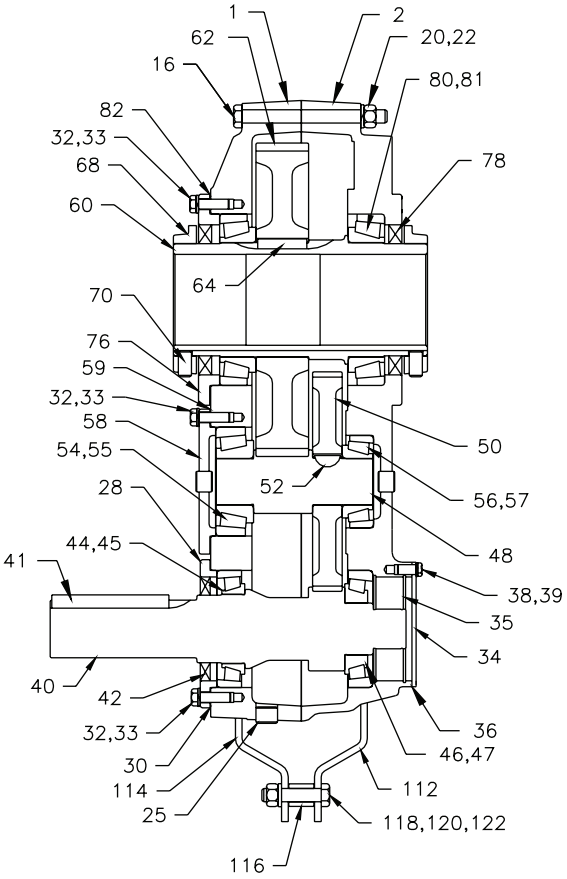
Ref.	Description	Qty.	TXT3B HXT3B	TXT4B HXT4B	TXT5C HXT5C
12	Backstop Assembly	1	243106	244106	245154
1	Housing - TXT and Hydroil LH	1	243228	244365	245369
2	Housing-RH	1	243229	244366	245370
	Housing-RH, Flange Mount Drilled	1	243384	244387	245373
①	RTV Sealant, Tube	1	465044	465044	465044
①	Air Vent	1	900287	900287	904287
16	Housing Bolt	6	411440	411442	411464
18	Housing Bolt-Adapter	2	411442	411444	411466
20	Lock-Washer	8	419012	419012	419013
22	Hex Nut	8	407089	407089	407091
①	Dowel Pin	2	420146	420146	420147
①	Magnetic Oil Plug	1	430060	430060	430062
25	Oil Plug	4	430031	430031	430033
28	Input Shaft Seal Carrier	1	243543	244577	245597
30	Input Shaft Bearing Shim Pack	⑧	389704	389711	389732
32	Input Seal Carrier Screw	⑦	411390	411407	411407
33	Lock Washer	⑦	419010	419011	419011
34	Backstop Cover	1	243560	244493	245226
38	Backstop Shaft Cover	4	416524	411035	411394
39	Backstop Cover Screw	4	N/A	N/A	419009
	Seal Kit ②	1	389720	389721	389722
36	Backstop Cover Gasket ④	1	243561	244593	245220
42	Input Pinion Shaft Seal ④	1	243558	244524	355011
78	Output Hub Oil Seal ④	2	243578	244673	245545
40	Input Pinion				
	9:1 Ratio ⑥	1	243549	244579	245599
	15:1 Ratio ⑥	1	243550	244580	245600
	25:1 Ratio ⑥	1	243551	244581	245601
130	15:1 Ratio Hydroil Pinion ⑥	1	243553	244583	245603
	25:1 Ratio Hydroil Pinion ⑥	1	243554	244584	245604
	15:1 Ratio Hydroil 6-B Pinion ⑥	1	N/A	244586	N/A
	25:1 Ratio Hydroil 6-B Pinion ⑥	1	243498	244587	245641
41	Input Pinion Shaft Key	1	443032	443082	443096
	Input Bearing Kit ②	1	389587	389590	389594
44	Input Shaft Bearing Cone, Input Side ④	1	402204	402280	402144
45	Input Shaft Bearing Cup, Input Side ④	1	403139	403027	403104
46	Input Shaft Bearing Cone, Backstop Side ④	1	402273	402142	402266
47	Input Shaft Bearing Cup, Backstop Side ④	1	403094	403102	403073
	Countershaft Pinion Assembly ②	1			
	9:1 Ratio ⑥	1	389729	389730	389731
	15:1 Ratio ⑥	1	389700	389707	389714
	25:1 Ratio ⑥	1	389701	389708	389715
48	Countershaft Pinion ④	1	243555	244590	245596
50	First Reduction Gear ④	1			
	9:1 Ratio ⑥	1	243237	244482	245482
	15:1 Ratio ⑥	1	243238	244214	245214
	25:1 Ratio ⑥	1	243239	244212	245212
52	First Stage Gear Key ④	1	D8242	D8243	D8243
	Countershaft Bearing Kit ②	1	389588	389591	389595
54	Countershaft Bearing Cone, Input Side ④	1	402273	402000	402203
55	Countershaft Bearing Cup, Input Side ④	1	403094	403000	403027
56	Countershaft Bearing Cone, Backstop Side ④	1	402273	402000	402203
57	Countershaft Bearing Cup, Backstop Side ④	1	403094	403000	403027
58	Countershaft Bearing Cover, Input Side ④	1	243545	244578	245594
59	Countershaft Bearing Shim Pack	⑧	389705	389712	389718
	Taper Bore Output Hub Assembly ②	1	389703	389710	389717
	Straight Bore Output Hub Assembly ③	1	389702	389709	389716
60	Output Hub				
	Straight Bore ⑤	1	243557	244589	245591
	Taper Bore ④	1	243556	244588	245590
62	Output Gear ④ ⑤	1	243570	244188	245186
64	Output Gear Key ④ ⑤	1	243216	354087	355064
68	Output Hub Collar, Straight Bore	2	243572	244658	245598
70	Output Hub Collar Screw	4	400098	400150	400154
72	Bushing Backup Plate, Taper Bore	2	243308	244099	245114
74	Bushing Backup Plate Retaining Ring	2	421109	421108	421107
76	Output Hub Seal Carrier, Input Side	1	243547	244591	245592
	Output Hub Bearing Kit	1	389589	389592	389596
80	Output Hub Bearing, Cone ④	2	402272	402268	402193
81	Output Hub Bearing, Cup ④	2	403127	403163	403016
82	Output Hub Bearing Shim Kit	⑧	389706	389713	389719

Parts for TXT3B thru TXT5C Straight and Tapered Bushed Double Reduction Reducer, continued

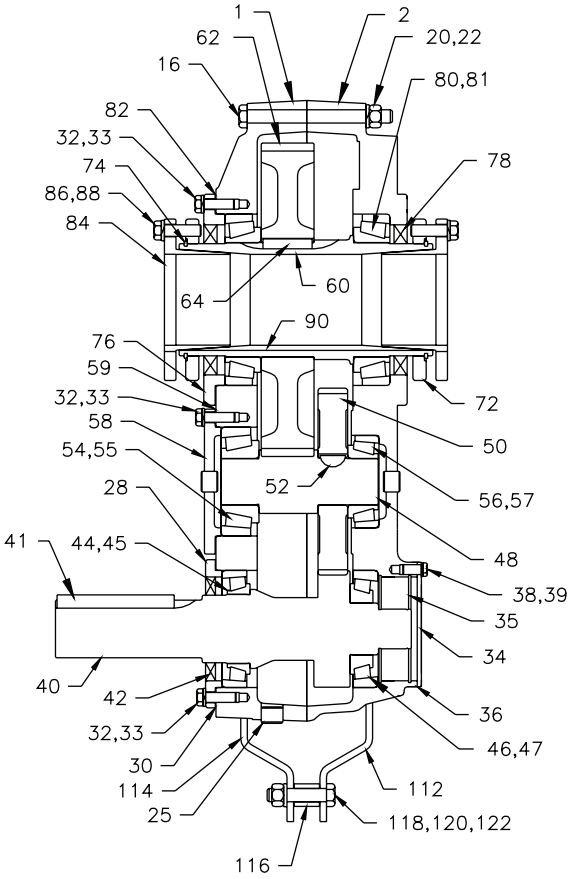
Ref.	Description	Qty.	TXT3B HXT3B	TXT4B HXT4B	TXT5C HXT5C
84	Taper Bore Bushing Assembly ②				
	Bushing ④				
	1-5/16" Bore	1	243282	N/A	N/A
	1-3/8" Bore	1	243284	N/A	N/A
	1-7/16" Bore	1	243260	244079	N/A
	1-1/2" Bore	1	243262	244081	N/A
	1-5/8" Bore	1	243264	244083	N/A
	1-11/16" Bore	1	243268	244085	N/A
	1-3/4" Bore	1	243266	244087	N/A
	1-7/8" Bore	1	243270	244089	245084
	1-15/16" Bore	1	243272	244093	245086
	2" Bore	1	243274	244095	245088
	2-1/8" Bore	1	N/A	244109	N/A
	2-3/16" Bore	1	243276	244111	245090
	2-1/4" Bore	1	N/A	244113	245092
	2-7/16" Bore	1	N/A	244115	245094
	2-1/2" Bore	1	N/A	N/A	245099
	2-11/16" Bore	1	N/A	N/A	245110
	2-15/16" Bore	1	N/A	N/A	245112
86	Taper Bushing Screw ④	6	411407	411408	411435
88	Taper Bushing Lockwasher ④	6	419011	419011	419012
90	Key, Bushing to Shaft ④				
	1-5/16" Bore	1	443264	N/A	N/A
	1-3/8" Bore	1	443264	N/A	N/A
	1-7/16" Bore	1	443265	443254	N/A
	1-1/2" Bore	1	443265	443254	N/A
	1-5/8" Bore	1	443265	443254	N/A
	1-11/16" Bore	1	443266	443254	N/A
	1-3/4" Bore	1	443266	443254	N/A
	1-7/8" Bore	1	443267	443255	443251
	1-15/16" Bore	1	443269	443255	443251
	2" Bore	1	443268	443255	443251
	2-1/8" Bore	1	N/A	443258	N/A
	2-3/16" Bore	1	443270	443259	443251
	2-1/4" Bore	1	N/A	443260	443251
	2-7/16" Bore	1	N/A	443261	443243
	2-1/2" Bore	1	N/A	N/A	443244
	2-11/16" Bore	1	N/A	N/A	443245
	2-15/16" Bore	1	N/A	N/A	443250
①	Key, Bushing to Output Hub ④				
	1-3/4" thru 1-15/16" Bore Bushing	1	443262	N/A	N/A
	1-7/16" thru 2-1/4" Bore Bushing	1	N/A	N/A	443202
	2-3/16" thru 2-15/16" Bore Bushing	1	N/A	443257	N/A
	Torque-Arm Rod Kit ②	1	243097	243097	243097
94	Torque-Arm Rod End ④	1	243245	243245	243245
96	RH Nut ④	1	407095	407095	407095
98	Torque-Arm Turnbuckle ④	1	243246	243246	243246
100	Torque-Arm Extension ④	1	243247	243247	243247
102	LH Nut ④	1	407244	407246	407246
104	Fulcrum ④	1	243249	243249	243249
106	Fulcrum Screw ④	1	411484	411484	411484
110	Hex Nut ④	1	407093	407093	407093
	Adapter Assembly ②	1	259153	259154	259155
112	RH Adapter Plate ④	1	243242	244244	245242
114	LH Adapter Plate ④	1	243241	244243	245241
116	Adapter Bushing ④	1	243243	245243	245243
118	Adapter Bolt ④	1	411437	411460	411460
120	Lockwasher ④	1	419012	419013	419013
122	Hex Nut ④	1	407089	407091	407091
	Hydroil Motor Adapter				
124	15:1 Ratio Motor Adapter	1	243539	244572	245606
126	25:1 Ratio Motor Adapter	1	243541	244572	245607
128	Hydroil 6-B Motor Adapter, 15:1 and 25:1 Ratio	1	243467	244573	245643
§	Adapter Screw	⑦	417081	417108	415023
§	Lockwasher	⑦	419046	419047	419047
	Motor to Adapter Screw				
	Motor to Adapter Lock Washer				

Notes:
① Not shown on drawing.
② Includes parts listed immediately below
③ Includes parts listed immediately below
④ Makes up assembly under which it is listed.
⑤ Makes up assembly under which it is listed.
⑥ See Table 9 for actual ratio.
⑦ 4 required on TXT3B and TXT4B, 5 required on TXT5C
⑧ Two sets recommended.

Parts for TXT6A thru TXT10A Straight and Tapered Bushed double Reduction Reducers



STRAIGHT BORE



TAPER BORE

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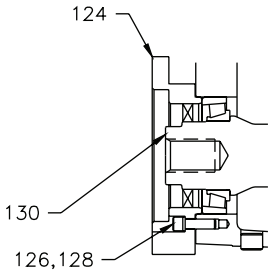
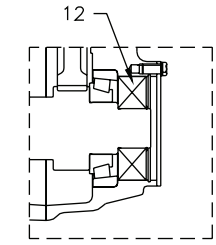
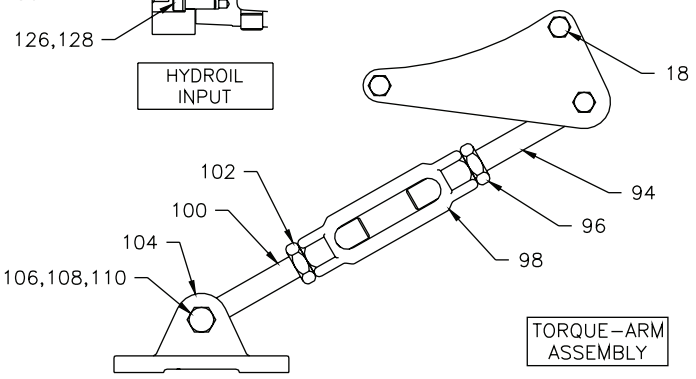


HYDROIL INPUT



BACKSTOP ASSEMBLY



TORQUE–ARM ASSEMBLY

Parts for TXT6A thru TXT10A Straight and Tapered Bushed double Reduction Reducers

Ref.	Description	Qty.	TXT6A HXT6A	TXT7A HXT7A	TXT8A	TXT9A	TXT10A
12	Backstop Assembly	1	246092	247260	249260	249260	250260
1	Housing-TXT and Hydroil LH	1	246358	247358	248358	249358	250358
2	Housing-RH	1	246359	247359	248359	249359	250359
	Housing-RH, Flange Mount Drilled	1	465044	465044	465044	465044	
①	RTV Sealant, Tube	1	904287	904287	904287	904287	465044
①	Air Vent	1	411466	411498	411499	411500	904287
16	Housing Bolt	2	411468	411499	411502	411502	411502
18	Housing Bolt-Adapter	2	419013	419016	419016	419016	411506
20	Lock-Washer	1	407091	407095	407095	407095	419016
22	Hex Nut	4	420147	420148	420148	420148	407095
①	Dowel Pin	2	430062	430064	430064	430064	420148
25	Magnetic Oil Plug	1	430033	430035	430035	430035	430064
①	Oil Plug	4	246184	247320	258023	249211	430035
28	Input Shaft Seal Carrier	1	391164	390420	390038	390168	249211
30	Input Shaft Bearing Shim Pack	⑧	411408	411433	411408	411408	390168
32	Carrier and Cover Screw	⑨	419011	419012	419011	419011	411408
33	Lock Washer	⑨	246226	246226	248226	248226	419011
34	Backstop Cover	1	421029	421029	421034	421034	248226
35	Backstop Retaining Ring	⑦	411394	411394	411394	411394	421034
38	Backstop Cover Screw	6	419009	419009	419009	419009	411394
39	Backstop Cover Lock Washer	6					419009
	Seal Kit ②	1	246340	247345	248340	249340	272460
36	Backstop Cover Gasket ③	1	246220	246220	248220	248220	248220
42	Input Pinion Shaft Seal ③	1	242210	242210	248211	248211	248211
78	Output Hub Oil Seal ③	2	246310	247310	258019	249210	250010
40	Input Pinion						
	9:1 Ratio ⑥	1	246481	247479	N/A	N/A	N/A
	15:1 Ratio ⑥	1	246290	247370	248370	272074	250300
	25:1 Ratio ⑥ ⑩	1	246291	247371	248371	272106	250004
130	15:1 Ratio Hydroil Pinion ⑥	1	246230	247463	N/A	N/A	N/A
	25:1 Ratio Hydroil Pinion ⑥	1	246286	247462	N/A	N/A	N/A
	15:1 Ratio 6B Hydroil Pinion ⑥	1	N/A	N/A	N/A	N/A	N/A
	25:1 Ratio 6B Hydroil Pinion ⑥	1	246521	247521	N/A	N/A	N/A
41	Input Pinion Shaft Key	1	443113	443127	443133	443123	443123
	Input Bearings						
44	Input Shaft Bearing Cone, Input Side	1	402196	402150	402098	402114	402114
45	Input Shaft Bearing Cup, Input Side	1	403091	403106	403072	403080	403080
46	Input Shaft Bearing Cone, Backstop Side	1	402197	402088	402097	402107	402112
47	Input Shaft Bearing Cup, Backstop Side	1	403091	403047	403072	403076	403080
	Countershaft Pinion Assembly ②						
	9:1 Ratio ⑥	1	392140	392141	N/A	N/A	N/A
	15:1 Ratio ⑥	1	391171	391196	391184	390124	390983
	25:1 Ratio ⑥ ⑩	1	391186	391197	391185	390139	390998
48	Countershaft Pinion ③	1	246294	247002	248002	249006	272249
50	First Reduction Gear ③						
	9:1 Ratio ⑥	1	246482	247478	N/A	N/A	N/A
	15:1 Ratio ⑥	1	246492	247008	248213	249008	250301
	25:1 Ratio ⑥ ⑩	1	246293	247005	248214	249005	250005
52	First Stage Gear Key ③	1	245218	247218	248218	248218	248218
	Countershaft Bearings						
54	Countershaft Bearing Cone, Input Side	1	402054	402256	402057	402109	402232
55	Countershaft Bearing Cup, Input Side	1	403159	403053	403143	403078	402231
56	Countershaft Bearing Cone, Backstop Side	1	402052	402256	402148	402109	402232
57	Countershaft Bearing Cup, Backstop Side	1	403142	403053	403106	403078	402231
58	Countershaft Bearing Cover, Input Side	1	246185	247194	248223	249225	272251
59	Countershaft Bearing Shim Pack	⑧	391165	390429	391182	390168	390575
	Taper Bore Output Hub Assembly ②	1	390935	390941	390944	390949	390954
	Straight Bore Output Hub Assembly ④	1	390988	390990	390993	390159	390160
60	Straight Bore Hub ⑤	1	246338	247338	248332	250090	250008
	Taper Bore Hub ③	1	246269	272137	272036	249140	272241
62	Output Gear ③ ⑤	1	246295	247215	248215	021764	250007
64	Output Gear Key ③ ⑤	2	245217	245217	248217	443413	250017
68	Output Hub Collar, Straight Bore	2	246309	247309	248209	249209	250009
70	Output Hub Collar Screw	4	400154	400190	400190	400194	400194
72	Bushing Backup Plate, Taper Bore	2	246270	272138	272037	272082	272242
74	Output Hub Retaining Ring	2	421055	421099	421098	421097	421069
76	Output Hub Seal Carrier, Input Side	1	246187	247315	258021	249221	250011
	Output Hub Bearing Kit 1	1	402050	402058	402147	402160	402168
80	Output Hub Bearing, Cone	2	403140	403111	403105	403110	403116
81	Output Hub Bearing, Cup	2	391187	390044	390048	390171	390172
82	Output Hub Bearing Shim Kit	⑧					

Parts for TXT6A thru TXT10A Straight and Tapered Bushed double Reduction Reducers							
Ref.	**Description**	**Qty.**	**TXT6A**	**TXT7A**	**TXT8A**	**TXT9A**	**TXT10A**
84	Taper Bore Bushing Assembly ②						
	Bushing ③						
	2-3/16" Bore	1	246261	N/A	N/A	N/A	N/A
	2-1/4" Bore	1	246262	N/A	N/A	N/A	N/A
	2-7/16" Bore	1	246263	272125	N/A	N/A	N/A
	2-1/2" Bore	1	246264	N/A	N/A	N/A	N/A
	2-11/16" Bore	1	246265	272147	N/A	N/A	N/A
	2-13/16" Bore	1	N/A	272130	N/A	N/A	N/A
	2-7/8" Bore	1	246266	272131	N/A	N/A	N/A
	2-15/16" Bore	1	246267	272132	272048	N/A	N/A
	3" Bore	1	246283	272133	N/A	N/A	N/A
	3-3/16" Bore	1	N/A	272134	N/A	N/A	N/A
	3-7/16" Bore	1	246268	272135	272032	N/A272056	N/A
	3-15/16" Bore	1	N/A	272136	272033	272077	272214
	4-3/16" Bore	1	N/A	N/A	272034	N/A	N/A
	4-7/16" Bore	1	N/A	N/A	272035	272079	272238
	4-15/16" Bore	1	N/A	N/A	N/A	272080	272239
	5-7/16" Bore	1	N/A	N/A	N/A	N/A	272240
86	Taper Bushing Screw ③	6	411435	411456	411457	411484	411484
88	Taper Bushing Lockwasher ③	6	419012	419013	419013	419014	419014
90	Key, Bushing to Shaft ③	1	443211	N/A	N/A	N/A	N/A
	2-3/16" Bore	1	443211	N/A	N/A	N/A	N/A
	2-1/4" Bore	1	443214	443248	N/A	N/A	N/A
	2-7/16" Bore	1	443214	N/A	N/A	N/A	N/A
	2-1/2" Bore	1	443238	443248	N/A	N/A	N/A
	2-11/16" Bore	1	N/A	443199	N/A	N/A	N/A
	2-13/16" Bore	1	443236	443199	N/A	N/A	N/A
	2-7/8" Bore	1	443237	443199	N/A	N/A	N/A
	2-15/16" Bore	1	443252	443199	443247	N/A	N/A
	3" Bore	1	N/A	443216	N/A	N/A	N/A
	3-3/16" Bore	1	443213	443235	N/A	N/A	N/A
	3-7/16" Bore	1	N/A	443217	443171	443249	N/A
	3-15/16" Bore	1	N/A	443218	443173	272119	443192
	4-3/16" Bore	1	N/A	N/A	443174	N/A	N/A
	4-7/16" Bore	1	N/A	N/A	443196	272066	443193
	4-15/16" Bore	1	N/A	N/A	N/A	443161	443194
	5-7/16" Bore	1	N/A	N/A	N/A	N/A	443195
①	Key, Bushing to Output Hub ③						
	2-3/16" thru 2-1/2" Bore Bushing	1	443212	N/A	N/A	N/A	N/A
	2-7/16" thru 3" Bore Bushing	1	N/A	443198	N/A	N/A	N/A
	2-3/16" thru 2-15/16" Bore Bushing	1	N/A	N/A	N/A	N/A	N/A
	2-15/16" thru 3-7/16" Bore Bushing	1	N/A	N/A	443162	N/A	N/A
	3-7/16" thru 4-3/16" Bore Bushing	1	N/A	N/A	N/A	443121	N/A
	3-15/16" thru 4-7/16" Bore Bushing	1	N/A	N/A	N/A	N/A	443191
	Torque-Arm Rod Kit ②	1	246097	247098	390129	390129	390129
94	Torque-Arm Rod End ③	1	245245	247239	271050	271050	271050
96	RH Nut ③	1	407097	407099	407104	407104	407104
98	Torque-Arm Turnbuckle ③	1	245246	247246	271051	271051	271051
100	Torque-Arm Extension ③	1	245247	247240	271052	271052	271052
102	LH Nut ③	1	407246	407248	407250	407250	407250
104	Fulcrum ③	1	247248	247248	271054	271054	271054
106	Fulcrum Screw ③	1	411489	411489	411516	411516	411516
108	Lockwasher ③	1	419014	419014	419020	419020	419020
110	Hex Nut ③	1	407093	407093	407099	407099	407099
	Adapter Assembly ②	1	259156	259157	248110	249110	250110
112	RH Adapter Plate ③	1	246242	247242	272053	249241	250041
114	LH Adapter Plate ③	1	246241	247241	272053	249241	250041
116	Adapter Bushing ③	1	245243	247244	271046	271046	211046
118	Adapter Bolt ③	1	411460	411489	411510	411512	411512
120	Lockwasher ③	1	419013	419014	419020	419020	419020
122	Hex Nut ③	1	407091	407093	407099	407099	407099
124	Hydroil Motor Adapter	1	246465	247464	N/A	N/A	N/A
	Hydroil 6B Motor Adapter	1	246522	247522	N/A	N/A	N/A
126	Hydroil Adapter Screw	6	417108	417141	N/A	N/A	N/A
128	Lockwasher	6	906406	907406	N/A	N/A	N/A
①	Motor to Adapter Screw						
①	Motor to Adapter Lock Washer						

Notes:
① Not shown on drawing
② Includes parts listed immediately below
③ Makes up assembly under which it is listed
④ Includes parts listed immediately below marked
⑤ Makes up assembly under which it is listed
⑥ See Table 9 for actual ratio
⑦ Required only with optional backstop, 1 required on TXT6A and TXT7A, 2 required on TXT8A, TXT9A, & TXT10A.
⑧ 2 sets recommended
⑨ 18 Required on TXT6A, 20 Required on TXT7A, and 24 Required on TXT8A, TXT9A, & TXT10A
⑩ Nominal Ratio on TXT6A, TXT7A, and TXT8A is 25:1, Nominal Ratio on TXT9A is 26:1, and Nominal Ratio on TXT10A is 24:1

ACTUAL RATIOS

Table 9 – Actual Ratios			
Reducer Size	Nominal Ratios		
	9:1	15:1	25:1*
TXT1A	9.44	15.35	25.64
TXT2A	9.25	14.10	23.46
TXT3B	8.91	14.88	24.71
TXT4B	9.67	15.13	24.38
TXT5C	8.95	15.40	25.56
TXT6A	9.20	15.33	25.13
TXT7A	9.61	15.23	24.59
TXT8A	N/A	15.08	24.62
TXT9A	N/A	15.12	25.66
TXT10A	N/A	15.16	24.30

* TXT9A is 26:1 Nominal Ratio and TXT10A is 24:1 Nominal Ratio

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APPENDIX H

INSTRUCTION MANUAL FOR DODGE® TORQUE-ARM™ SPEED REDUCER BACKSTOPS

These instructions must be read thoroughly before installing or operating this product.

WARNING: To ensure that drive is not unexpectedly started, turn off and lock out or tag power source before proceeding. Failure to observe these precautions could result in bodily injury.

WARNING: Do not use Dodge backstops in any reducers other than Dodge brand reducers.

CAUTION: Do not use EP oils or oils containing slippery additives such as graphite or molybdenum disulphide in the reducer when backstop is used. These additives will destroy sprag action.

INSTALLATION OF BACKSTOP

1. Remove backstop cover plate. This plate is directly opposite the extended end of the input shaft.
2. Face reducer looking at the side from which the cover plate was removed. Determine carefully the direction of rotation desired. The directions of rotation of input and output shafts are identical in double reduction reducers (Nos. TXT115 thru TXT1225 and TDT1325 thru TDT1530) and opposite in single reduction reducers (Nos. TXT105 to TXT905). It is important that the direction be correctly determined because to reverse the direction after the backstop is installed, it is necessary to remove the backstop, turn it end for end and reinstall it.
3. Match arrow on backstop to direction of rotation desired for input shaft. Note that reversing backstop end for end changes direction of arrow. The input shaft will rotate in the same direction as the arrow on the backstop.
4. Proceed as follows:
   Nos. TXT1A to TXT5C and Nos. TXT105 to TXT505A Reducers —For ease of installation, a light coating of oil on the O.D. of backstop will help to rotate backstop for key installation. Slowly rotate input shaft in same direction as arrow on backstop. Without removing cardboard retainer from backstop, push backstop into reducer. When pushing backstop into reducer, it is very important not to hammer on backstop although it can be tapped gently if necessary. Cardboard retainer will be pushed out automatically as backstop is pushed into reducer. If backstop has to be removed for any reason, pull backstop from bore and insert cardboard retainer into I.D. of backstop to retain position of sprag. After rotation is verified, discard cardboard retainer. Ensure backstop cover does not bind backstop.

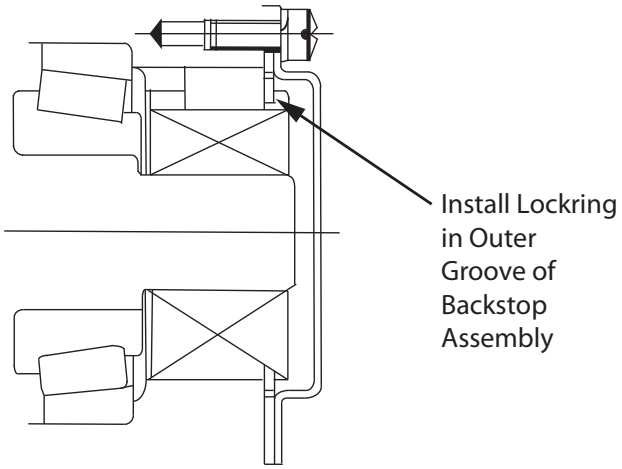

Figure 1 - TXT3B

NOTE: A locking ring is required on TXT3B to position backstop in housing.

Nos. TXT6A, TXT7A and No. TXT605 Reducers —For ease of installation, a light coating of oil on the O.D. of backstop will help to rotate backstop for key installation. Some of the backstops have keys of different lengths. Place the longer key in the input shaft keyseat. For ease of installation, backstop complete with inner race must be pushed into reducer as a unit. When pushing backstop into reducer, it is very important not to hammer on backstop although it can be tapped gently if necessary. Place small snap ring in snap ring groove on input shaft, and place large snap ring in groove in housing outboard of backstop.

Nos. TXT8 to TXT12, TDT13 thru TDT15, TXT705 to TXT905 Reducers — Place large snap ring in I.D. of housing or bacsktop carrier. For ease of installation, a light coating of oil on the O.D. of backstop will help to rotate backstop for key installation. Backstop complete with inner race must be pushed into reducer as a unit. When pushing backstop into Reducer, it is very important not to hammer on backstop although it can be tapped gently if necessary. Place the small snap ring in snap ring groove on input shaft, and place second large snap ring in housing outboard of backstop for sizes TXT8A, TXT9A and TXT10A.

WARNING: Because of the possible danger to person(s) or property from accidents which may result from the improper use of products, it is important that correct procedures be followed: Products must be used in accordance with the engineering information specified in the catalog. Proper installation, maintenance and operation procedures must be observed. The instructions in the instruction manuals must be followed. Inspections should be made as necessary to assure safe operation under prevailing conditions. Proper guards and other suitable safety devices or procedures as may be desirable or as may be specified in safety codes should be provided, and are neither provided by Baldor Electric Company nor are the responsibility of Baldor Electric Company. This unit and its associated equipment must be installed, adjusted and maintained by qualified personnel who are familiar with the construction and operation of all equipment in the system and the potential hazards involved. When risk to persons or property may be involved, a failsafe device must be an integral part of the driven equipment beyond the speed reducer output shaft.

DODGE®

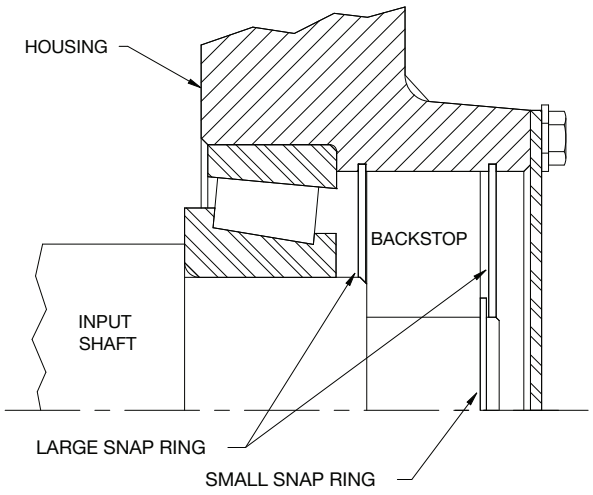

Figure 2 - TXT8A, 9A, 10A

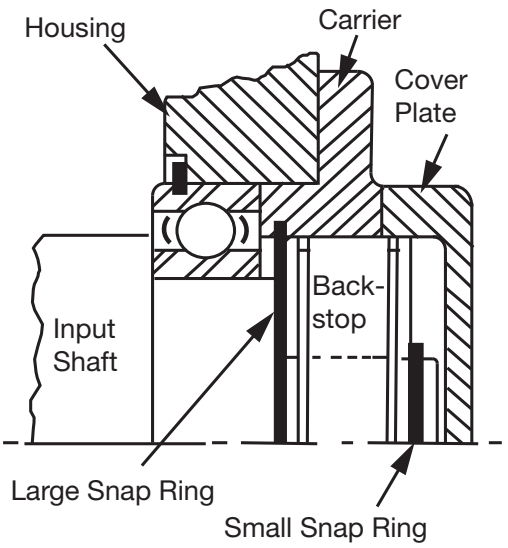

Figure 3 - TXT12, TDT 13-15, TXT805-905

Some of the backstops require two keys on the input pinion. Dispose of extra key with units that require only one key. Line up keyways between backstop and input pinion. Install key(s).

5. Insert key between housing and backstop O.D. and replace gasket, cover plate and screws. When input shaft will be located higher than output shaft, put some non-EP grease in cover plate for the purpose of lubricating backstop. Use a high grade non-EP grease made especially for roller bearing service.

NOTE: Some backstops have keys that are rectangular in cross section. Keys should fit freely into respective keyways. Forcing keys into place could result in premature failure of backstop.

TO REMOVE BACKSTOP

WARNING: To ensure that drive is not unexpectedly started, turn off and lock out or tag power source before proceeding. Failure to observe these precautions could result in bodily injury.

WARNING: Removal of backstop may cause unexpected machine movement. Remove or block all external loads before servicing unit. Failure to observe these precautions could result in bodily injury.

1. Remove backstop cover plate.
2. Remove snap ring from end of shaft (snap ring is used only on Nos. TXT609 to TXT1225 and TDT1325 thru TDT1530 and Nos. TXT605 to TXT905 reducers).
3. Insert tool, such as a screwdriver, in groove around O.D. of backstop and pry backstop from retainer housing. If backstop hs tapped holes in outer race, install two #10-24 machine screws in holes and use them to pry backstop from housing.

DIMENSIONAL CHECKS FOR REPLACEMENT UNITS IN REDUCERS WITH TAPERED ROLLER BEARINGS

Shaft Endplay: While the backstop is removed check the amount of endplay in the shaft if tapered roller bearings are used. It is possible that bearing wear or looseness might have increased the amount of endplay to an unacceptable level. Shaft endplay should not exceed .003". Endplay is measured with a dial indicator at the end of the backstop shaft. The base of the indicator is attached to the reducer housing. From the other end of the shaft, an axial force must be applied in both directions. While rotating shaft, push and pull.

CONCENTRICITY:

The amount of Total Indicated Run Out (T.I.R.) between the inner race (shaft) and the backstop bore in the housing is a critical measurement. It takes into consideration the effects of bearing endplay as well as machining eccentricities. The T.I.R. should not exceed .003" on TXT309B to TXT1225 and .004" T.I.R. on TDT1325 to TDT1530. The base of the dial indicator can be mounted on the end of the shaft as shown, with the needle at the backstop bore in the housing. Rotate the shaft, sweeping the bore 360° which will give T.I.R.

DIMENSIONS:

Verify input shaft diameter at the backstop journal. See chart for correct dimensions.

NOTES:

1. TXT1 thru TXT6 — When replacing failed backstop, inspect shaft end for condition. Journal should be smooth and free of damage. See Fig. 1.
2. On older TXT12 thru TDT15, it is suggested that external backstop carrier be doweled to housing after concentricity is verified.
3. If reducer must be positioned with backstop above static level of oil, contact factory for lubrication recommendations before placing reducer in service.

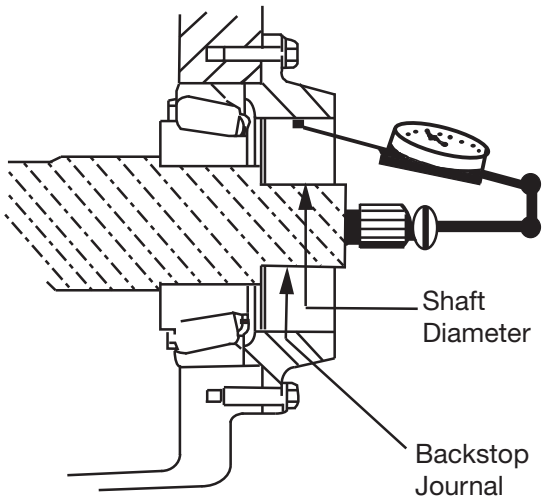

Figure 4

TORQUE-ARM SPEED REDUCER BACKSTOP							
PART NUMBER	**CURRENT TXT SERIES HOUSING REDESIGN 2005**	**TXT SERIES BEARING REDESIGN 1991**	**TXT SERIES INTRO 1985**	**TDT SERIES**	**TD SERIES**	**NUMBER SERIES**	**SHAFT DIMENSIONS**
241101				TDT 115 TDT 125	TDT 115 TDT 125	No. 1	.6315/.6310
242101	TXT109A TXT115A TXT125A		TXT 105 TXT 109 TXT 115 TXT 125	TDT 215 TDT 225 T 11	TDT 215 TDT 225	No. 2 No. 3 No. 11	.7383/.7378
243101				TDT 315 TDT 325	TDT 315 TDT 325		.9706/.9696
243102			TXT 309 TXT 315 TXT 325				.8891/.8881
243106	TXT309B TXT315B TXT325B	TXT 309A TXT 315A TXT 325A					.7383/.7378
244092				TDT 415 TDT 425	TDT 415 TDT 425		.9706/.9696
244101						No. 4 No. 5	1.1355/1.1325
244106	TXT409B TXT415B TXT425B	TXT 409A TXT 415A TXT 425A					.8891/.8881
244148			TXT 405 TXT 409 TXT 415 TXT 425				1.0521/1.0511
245101				TDT 515 TDT 525	TDT 515 TDT 525		1.2965/1.2955
245154	TXT509C TXT515C TXT525C	TXT 509B TXT 515B TXT 525B	TXT 509, 509A TXT 515, 515A TXT 525, 525A				1.2150/1.2140
246092	TXT609A TXT615A TXT625A		TXT 605 TXT 609 TXT 615 TXT 625	TDT 615 TDT 625 T 16	TDT 615 TDT 625 TDT 615A TDT 625A	No. 16A	1.5005/1.5000
246101		TXT 505A	TXT 505	T 15		No. 6	1.2965/1.2955
247092		Use Part Number 247260					
247101						No. 7A	1.5405/1.5400
247260	TXT709A TXT715A TXT725A		TXT 705 TXT 709 TXT 715 TXT 725	TDT 715 TDT 725 T 17	TDT 715 TDT 725 TDT 715A TDT 725A	No. 17A	1.5005/1.5000
248101		Use Part Number 249260					
249260	TXT815A TXT825A TXT15A TXT926A		TXT 815 TXT 825 TXT 915 TXT 926	TXT 815 TXT 825 TXT 915 TXT 926 TDT 1115 TDT 1125	TD 815 TD 825 TD 815A TD 825A TD 915 TD 1115 TD 1125	No. 8 No. 9 No. 18	1.7505/1.7500
250101		Use Part Number 249260					
250260	TXT1015A TXT1024A		TXT 805 TXT 1015 TXT 1024 TXT 1215 TXT 1225	TD 1015 TDT 1024 T 18 TDT 1215 TDT 1225	TD 1015 TD 1024 TD 1215 TD 1225		1.7505/1.7500
252101	TXT209A TXT215A TXT225A	TXT 305A	TXT 205 TXT 209 TXT 215 TXT 225 TXT 305	T 12 T 13		No. 13	.9706/.9696
254101				T 14		No. 14	1.1335/1.1325
255101						No. 15	1.5405/1.5400
256101						No. 16	1.7505/1.7500
257101						No. 17	1.7505/1.7500
272259			TXT 905	TDT 1325; T 19			1.9370/1.9360
272293				TDT 1425 TDT 1530			2.7495/2.7490

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APPENDIX I

Instruction Manual for DODGE®
Setscrew, Eccentric Collar, D-Lok, H-E Series & EZ-Kleen
Mounted Ball Bearings

These instructions must be read thoroughly before installation or operation.

WARNING: To ensure that drive is not unexpectedly started, turn off and lock out or tag power source before proceeding. Failure to observe these precautions could result in bodily injury.

CAUTION: Under certain operating conditions. It is possible for static electric charge to build up on EZ-KLEEN Polymer Housings. Do not operate these bearings in an environment where a sudden static discharge may cause either an operating hazard or personnel discomfort.

INSTALLATION:

1. Clean shaft and bearing bore thoroughly. Measure and confirm shaft size and tolerance. File flats on shaft at setscrew locations to permit easy removal of bearing.
2. Slip bearing into position. Be sure that bearing is not on a worn section of the shaft. For tighter fits, tap inner ring face only with soft driver. DO NOT HAMMER ON HOUSING.
3. The bearing outer ring OD is spherical and swivels in the housing to accommodate misalignment. Snug holddown bolts and use shaft to swivel each bearing until its final position is in the center of free movement top to bottom as well as side to side. Pass shaft through both bearings without forcing. This will prevent preloading of the bearings. Housing slippage depends on the mounting hold-down bolt tightening torque, number of bolts and friction characteristics between mounting surfaces. Auxiliary load carrying devices such as shear bars are advisable for side or end loading of pillow blocks and radial loads for flange units where normal to heavy loading or shock loading is encountered.

NOTE: On coated and non-metallic housings, hold-down bolts should be tightened carefully with flat washers to prevent damage to the coating. Coated housings have reduced friction characteristics, so auxiliary load carrying devices are even more important in those applications.

WARNING Because of the possible danger to persons(s) or property from accidents which may result from the improper use of products, it is important that correct procedures be followed: Products must be used in accordance with the engineering information specified in the catalog. Proper installation, maintenance and operation procedures must be observed. The instructions in the instruction manuals must be followed. Inspections should be made as necessary to assure safe operation under prevailing conditions. Proper guards and other suitable safety devices or procedures as may be desirable or as may be specified in safety codes should be provided, and are neither provided by Baldor Electric Company nor are the responsibility of Baldor Electric Company. This unit and its associated equipment must be installed, adjusted and maintained by qualified personnel who are familiar with the construction and operation of all equipment in the system and the potential hazards involved. When risk to persons or property may be involved, a holding device must be an integral part of the driven equipment beyond the speed reducer output shaft.

4. Tighten hold-down bolts to proper torque (Table 1). Turn shaft by hand. Resistance to turning should be the same as before full tightening of hold-down bolts.
5. For setscrew mounted bearings: After final alignment of the shaft, tighten both setscrews hand tight, then the setscrews should be tightened alternately and in small increments to the torque specified in Table 1. After 24 hours operation, the setscrews should be retightened to the torque in Table 1 to assure full locking of the inner race to the shaft. Care should be taken that the socket key or driver is in good condition with no rounded corners and the key is fully engaged in the setscrew and held square with the setscrew to prevent rounding out of the setscrew socket when applying maximum torque. Do not drill through the setscrew holes for spot drilling of the shaft. (Some inner rings have tempered setscrew threads and can be damaged by a drill.) If spot drilling is required, locate bearings on the shaft and center punch through the setscrew hole. Remove bearing and spot drill the shaft, then reassemble over the spot drilled position and assemble as above. Milled or filed flats are preferable to spot drilling.

NOTE: On all Setscrew Product the setscrews can be re-torqued many times without damage to the bearing system. To achieve maximum shaft holding power it is highly recommended that setscrews be replaced with new hardware after any disassembly operation.

6. For eccentric collar mounted bearings, slide collar against cam end of inner race. Use a punch in the hole provided in the collar, tap collar smartly in the direction of shaft rotation. Tighten setscrews to proper torque (Table 1). To remove bearings, loosen setscrew and tap collar in the direction opposite of shaft rotation.
7. For D-LOK mounted bearings, be sure collar is square and tight against shoulder on inner ring. Tighten cap screw to recommended torque shown in Table 1.
8. For expansion bearings (H-E Series), locate inner unit in housing to allow expansion in the desired direction before locking to the shaft.

DODGE®

Table 1 - Recommended Torque													
Setscrews					D-LOK			Mounting Bolts					
		Recommended Torque						Metal Housings		EZ-KLEEN Housed Bearings			
Set-screw Size	Key Hex Across Flats	Standard Ball Bearing Insert		Corrosion Resistant Stainless Steel	Cap Screw Size	Recom. Torque	EZ-Kleen Recom. Torque	Bolt Size	Recom. Dry Torque (Grade 2)	2-Bolt PB, 2 & 4 Bolt Flg. and Flg. Brackets		Tapped-Base PB	
		Min	Max							Bolt Size	Torque ①	Bolt Size	Torque ②
(in.)	(in.)	(in-lbs.)	(in-lbs.)	(in-lbs.)	(in.)	(in-lbs.)	(in-lbs.)	(in.)	(in-lbs.)	(in.)	(in-lbs.)	(in.)	(in-lbs.)
#10	3/32	28	33	25	#8-32	58	46	3/8-16	240	3/8-16	225	3/8-16	175
1/4	1/8	66	80	60	#10-32	90	72	7/16-14	384	7/16-14	350	7/16-14	350
5/16	5/32	126	156	117	1/4-28	180	144	1/2-13	600	1/2-13	500	1/2-13	400
3/8	3/16	228	275	206	5/16-24	400	320	5/8-11	1200	9/16-12	650		
7/16	7/32	342	428	321	3/8-24	750	600	3/4–10	1950	5/8-11	1000		
								7/8–9	2890				
(mm)	(mm)	(N-m)	(N-m)	(N-m)	(mm)	(N-m)	(N-m)	(mm)	(N-m)	(mm)	(N-m)	①Torque for Austenitic (18-8) Stainless ②Max. torque values published. Do not exceed.	
M5	2.5	3.2	3.7	2.8	M4	5.85	4.68	M10	29	M8	15		
M6	3	6.2	7.7	5.8	M5	10.75	8.6	M12	50	M10	25		
M8	4	14.2	17.8	13.4	M6	20.5	16.4	M16	124	M12	50		
M10	5	26	31	23	M8	45	36	M20	238	M14	75		
M12	6	46	57	43				M22	322	M18	125		

Lubrication

High Speed Operation - In the higher speed ranges, too much grease will cause over-heating. The amount of grease that the bearing will take for a particular high speed application can only be determined by experience. If excess grease in the bearing causes overheating, it will be necessary to remove grease fitting to permit excess grease to escape. The bearing has been greased at the factory and is ready to run. When establishing a relubrication schedule, note that a small amount of grease at frequent intervals is preferable to a large amount at infrequent intervals.

Lubrication Guide Use a No. 2 Lithium complex base grease or equivalent*								
Hours Run per Day	Suggested Lubrication Period in Weeks							
	1 to 250 RPM	251 to 500 RPM	501 to 750 RPM	751 to 1000 RPM	1001 to 1500 RPM	1501 to 2000 RPM	2001 to 2500 RPM	2501 to 3000 RPM
8	12	12	10	7	5	4	3	2
16	12	7	5	4	2	2	1	1
24	10	5	3	2	1	1	1	1
*For EZ-Kleen series bearings, use an aluminum complex base grease.								

Lubrication recommendations are intended for standard products applied in general operating conditions. For modified products, high temperature applications, and other anomalous applications contact product engineering at 864-284-5700.

3016-0711

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APPENDIX J

INSTRUCTION MANUAL
DODGE ® TYPE E BEARINGS
for 1 3/16" to 3" and 35mm to 75mm Bore

INSTALLATION INSTRUCTIONS

WARNING

To ensure that drive is not unexpectedly started, turn off and lock out or tag power source before proceeding. Failure to observe these precautions could result in bodily injury.

1. Clean shaft bore of bearing. Lubricate with light oil or antiseize compound.
2. Slip bearing in position.
3. Bolt bearing to support, using shims where necessary to align bearing.
4. Tighten setscrews to the torque values shown on Table 1.
5. The effort required to turn the shaft should be the same before and after bolting bearing to the support.

LUBRICATION INSTRUCTIONS

Storage or Special Shutdown — If exposed to wet or dusty conditions or to corrosive vapors, extra protection is necessary. Add grease until it shows at the seals; rotate the bearing to distribute grease; cover the bearing. After storage or idle period, add a little fresh grease before running.

High Speed Operation — In the higher speed ranges too much grease will cause overheating. The amount of grease that the bearing will take for a particular high speed application can only be determined by experience — see "Operating Temperature" below. If excess grease in the bearing caused overheating, it will be necessary to remove grease fitting (also drain plug when furnished) to permit excess grease to escape. The bearing has been greased at the factory and is ready to run. When establishing a relubrication schedule, note that a small amount of grease at frequent intervals is preferable to a large amount at infrequent intervals.

Operation in Presence of Dust, Water or Corrosive Vapors — Under these conditions the bearing should contain as much grease as speed will permit, since a full bearing with consequent slight leakage is the best protection against entrance of foreign material. In the higher speed ranges too much grease will cause overheating — see "High Speed Operation." In the lower speed ranges it is advisable to add extra grease to a new bearing before putting into operation. Bearings should be greased as often as necessary (daily if required) to maintain a slight leakage at the seals.

Average Operation — This bearing has been greased at the factory and is ready to run. The following table is a general guide for relubrication. However, certain conditions may require a change of lubricating periods as dictated by experience. See "High Speed Operation" and "Operating in Presence of Dust, Water, or Corrosive Vapors."

Operating Temperature — Abnormal bearing temperature may indicate faulty lubrication. Normal temperature may range from "cool to warm to the touch" up to a point "too hot to touch for more than a few seconds," depending on bearing size and speed, and surrounding conditions. Unusually high temperature accompanied by excessive leakage of grease indicates too much grease. High temperature with no grease showing at the seals, particularly if the bearing seems noisy, usually indicates too little grease. Normal temperature and a slight showing of grease at the seals indicate proper lubrication.

Kind of Grease — Many ordinary cup greases will disintegrate at speeds far below those at which DODGE ® bearings will operate successfully if proper grease is used. DODGE ® bearings have been lubricated at the factory with No. 2 consistency lithium complex-base grease which is suitable for normal operating conditions. Relubricate with lithium complex-base grease or a grease which is compatible with original lubricant and suitable for roller bearing service. In unusual or doubtful cases the recommendation of a reputable grease manufacturer should be secured.

Special Operating Conditions — Refer acid, chemical, extreme or other special operating conditions to DODGE/Reliance Electric Industrial Company, Greenville, S.C.

TABLE 1
Set Screw Torque Table

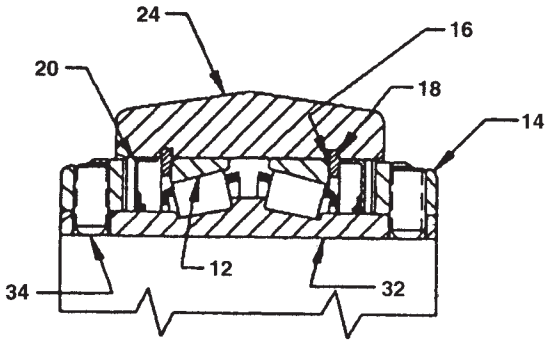
Shaft Size	Set Screw Size	Tightening Torque
1 3/16" - 1 11/16"	5/16 - 18	165 in.-lbs.
1 3/4" - 2 1/2"	3/8 - 16	290 in.-lbs.
2 11/16" - 3"	1/2 - 13	620 in. - lbs.
35 - 40MM	M8	17.8 NM
45 - 65MM	M10	35 NM
70 - 75MM	M12	57 NM

Lubrication Guide

Read Preceding Paragraphs Before Establishing Lubrication Schedule.

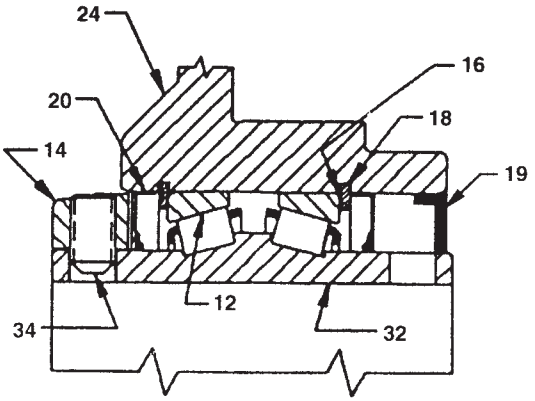
Hours Run per Day		Suggested Lubrication Period in Weeks						
	1 to 250 RPM	251 to 500 RPM	501 to 750 RPM	751 to 1000 RPM	1001 to 1500 RPM	1501 to 2000 RPM	2001 to 2500 RPM	2501 to 3000 RPM
8	12	12	10	7	5	4	3	2
16	12	7	5	4	2	2	2	1
24	10	5	3	2	1	1	1	1

WARNING: Because of the possible danger to persons(s) or property from accidents which may result from the improper use of products, it is important that correct procedures be followed: Products must be used in accordance with the engineering information specified in the catalog. Proper installation, maintenance and operation procedures must be observed. The instructions in the instruction manuals must be followed. Inspections should be made as necessary to assure safe operation under prevailing conditions. Proper guards and other suitable safety devices or procedures as may be desirable or as may be specified in safety codes should be provided, and are neither provided by Rockwell Automation nor are the responsibility of Rockwell Automation. This unit and its associated equipment must be installed, adjusted and maintained by qualified personnel who are familiar with the construction and operation of all equipment in the system and the potential hazards involved. When risk to persons or property may be involved, a holding device must be an integral part of the driven equipment beyond the speed reducer output shaft.



1 3/16" to 3" Type E Bearing

NOTE: The two-digit numbers are for reference only. Order parts by the six-digit numbers in the Parts List. Each six-digit number is a complete identification of the part or assembly.



Piloted Flange Bearing Only

Parts for 1 3/16" to 3" Type E Bearing

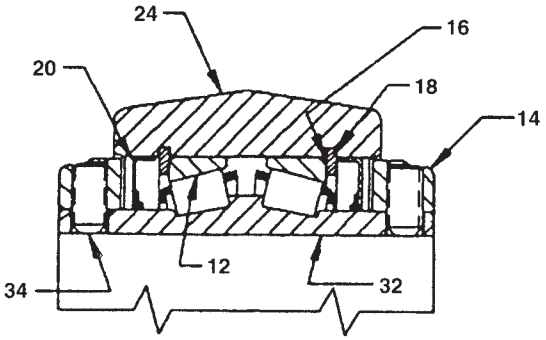
Reference	Name of Part	Required for One Assembly: Pillow Block	Flange Bearing	Piloted Flange Bearing	Take-Up Bearing	Part Number for Various Shaft Sizes: 1 3/16, 1 1/4	1 3/8, 1 7/16	1 1/2, 1 5/8, 1 11/16	1 3/4, 1 7/8, 1 15/16, 2	2 3/16	2 1/4, 2 7/16 2 1/2	2 11/16, 2 3/4, 2 15/16, 3
12	Cup	2	2	2	2	390748	390751	390755	403006	390762	390766	390771
14	Drive Collar °	2	2	1	2	060944	040050	040051	040052	040053	040054	040055
16	Adjustment Shim Pack	1 Set ‡	1 Set ‡	1 Set ‡	1 Set ‡	391101	391102	391103	391104	391105	391106	391107
..	.004" Thick Shim	†	†	†	†	427070	427071	427072	427073	427074	427075	427076
..	.006" Thick Shim	†	†	†	†	427080	427081	427082	427083	427084	427085	427086
..	.015" Thick Shim	†	†	†	†	427090	427091	427092	427093	427094	427095	427096
18	Snap Ring	2	2	2	2	401002	401004	401008	401012	401016	401020	401024
19	Shield	0	0	1	0	061368	061369	061370	061371	061372	061373	061374
20	Seal, Single Lip	2	2	2	2	061355	061356	061357	061358	061359	061360	061361
24	2-Bolt Gray Iron Pillow Block Hsg.	1	0	0	0	060400	060401	060402	060403	060404	060405	060406
24	4-Bolt Gray Iron Pillow Block Hsg.	1	0	0	0	....	....	....	....	....	060411	060412
↓	2-Bolt Cast Steel Pillow Block Hsg.	1	0	0	0	060052	060053	060054	060055	060056	060057	060058
	Top Angle Housing ▲	0	0	0	1	....	....	....	012265	012266	012267	012668
↓	Flange Housing	0	1	0	0	059100	059101	059102	059103	059104	059105	059106
28	Piloted Flange Housing	0	0	1	0	059168	059170	059171	059172	059173	059174	059175
↓	Wide Slot Take-Up Housing ▲	0	0	0	1	....	012350	012351	012352	012353	012354	012355
↓	Lubrication Fitting	1	1	1	1	405015	405015	405015	405015	405015	405015	405015

Reference	Name of Part	Part Number for Various Shaft Sizes: 1 3/16	1 1/4	1 3/8	1 7/16	1 1/2	1 5/8	1 11/16	1 3/4	1 7/8	1 15/16	....
32	Cone* °	389782	389783	389784	389785	389786	389787	389788	389789	389790	389791	....
34	Drive Collar Screw ■	400054	400054	400058	400058	400058	400058	40058	400094	400094	400094	....
Reference	Name of Part	2	2 3/16	2 1/4	2 7/16	2 1/2	2 11/16	2 3/4	2 15/16	3	....	....
32	Cone* °	389792	389793	389794	389795	389796	389797	389798	389799	389800	....	....
34	Drive Collar Screw ■	400094	400094	400094	400094	400094	400150	400150	400150	400150	....	....

‡ Consists of one each of the shims listed immediately below marked with a dagger. Usually one .015" shim and one .004" or .006" shim when required.
† Parts marked with a dagger make up the adjustment shim pack.
* One required.
■ Four required except for piloted flange bearing, which requires two.
↓ Not shown on drawing
° 65° setscrews angle.
▲ Uses 405016 lubrication fitting.

Shaft Tolerances: Up to 1 1/2" +.0000 - .0005
1 9/16" to 3" +.0000 -.0010

35mm to 75mm Type E Bearings



35mm – 75mm Type E Bearing

NOTE: The two-digit numbers are for reference only. Order parts by the six-digit numbers in the Parts List. Each six-digit number is a complete identification of the part or assembly.

Parts for 35MM to 75MM Type E Pillow Block Bearings

Item	24	32	12	14	18	16**	***	***	***	20	34	+
Shaft Size	Housing	Cone*	Cup	Collar*	Snap Ring	Shim Pack	0.004" Shim	0.006" Shim	0.015" Shim	Seal	Set Screw	Lube Fitting
35 MM	061320	389740	390751	046120	401004	391102	427071	427081	427091	061356	400713	405601
40 MM	061321	389741	390755	046121	401008	391103	427072	427082	427092	061357	400713	405601
45 MM	061322	389742	403006	046122	401012	391104	427073	427083	427093	061358	400708	405601
50 MM	061322	389743	403006	046122	401012	391104	427073	427083	427093	061358	400708	405601
55 MM	061323	389744	390762	046123	401016	391105	427074	427084	427094	061359	400709	405601
60 MM	061324	389745	390766	046124	401020	391106	427075	427085	427095	061360	400709	405601
65 MM	061324	389746	390766	046124	401020	391106	427075	427085	427095	061360	400709	405601
70 MM	061325	389747	390771	046125	401024	391107	427076	427086	427096	061361	400710	405601
75 MM	061325	389748	390771	046125	401024	391107	427076	427086	427096	061361	400710	405601
Quantity Per	1	1	2	2	2	1**	***	***	***	2	4	1

* 65° Set Screw Angle
** Consists of one each of 0.004", 0.006" and 0.015" shims
*** These parts make up shim pack
\+ Not shown on drawing

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APPENDIX K

INSTRUCTION MANUAL FOR DODGE® S-2000 SPHERICAL ROLLER BEARINGS

GENERAL INFORMATION

DODGE S-2000 Spherical Roller Bearing mounted units incorporate a unique way of sealing the internal components of the bearing while still allowing a full + or - 1 degree of misalignment. The patented sealing system (Pat. #5,908,249) has proven effective, due to its constant contact pressure, in protecting the internal bearing components under maximum allowable misaligned conditions.

INSTALLATION INSTRUCTIONS

NON-EXPANSION BEARING

WARNING
TO ENSURE THAT DRIVE IS NOT UNEXPECTEDLY STARTED, TURN OFF AND LOCK OUT OR TAG POWER SOURCE BEFORE PROCEEDING. FAILURE TO OBSERVE THESE PRECAUTIONS MAY RESULT IN BODILY INJURY.

1. Clean shaft and bore of bearing. The shaft should be straight, free of burrs and nicks, and correct size (see shaft tolerance table). If used shafting is utilized, then the bearing should be mounted on unworn section of shafting.
2. Lubricate shaft and bearing bore with grease or oil to facilitate assembly. Slip bearing into position. When light press fit is required, press against the end of the inner ring of bearing. Do not strike or exert pressure on the housing or seals.
3. Bolt bearing to support, using shims where necessary to align bearing so inner ring does not rub on seal carrier. Use full shims which extend across the entire housing base.
4. Determine final shaft postion and tighten setscrews in the locking collar(s) of non-expansion bearing to recommended torque while the other bearings remain free. Rotate the shaft slowly under load, if possible, to properly center the rolling elements with respect to the raceways. Then tighten setscrews into the locking collar of the remaining bearings to the recommended torque.
5. Check rotation. If there is any strain, irregular rotational torque or vibration, it could be due to incorrect alignment, bent shaft or bent supports. Installation should be rechecked and correction made where necessary.

EXPANSION BEARING

Steps (1, 2, 3) Same as Non-Expansion Bearing.

4. Position expansion bearing in the housing. For normal expansion conditions, the bearing insert should be positioned in the center of the housing. To center bearing insert in housing, move bearing insert to extreme position and mark shaft. Then using bearing maximum total expansion table, move bearing insert in opposite direction one-half the total expansion to center bearing in the housing. If maximum expansion is required, move bearing insert to the extreme position in the housing to permit full movement in direction of expansion. After expansion bearing has been positioned in the housing, tighten the setscrews in the locking collar to the recommended torque.
5. Same as Non-Expansion Bearing.

FIELD CONVERSION (RE-OP) OF A NON-EXPANSION BEARING INTO AN EXPANSION BEARING

All non-expansion bearing sizes can be re-oped to become expansion bearings. To re-op a non-expansion to an expansion bearing follow these steps:

1. Move the snap ring, opposite from the collar side of bearing, to the outermost snap ring groove.
2. Install bearing per Expansion Bearing instructions listed above.

NOTE: Bearing nameplate has a non-expansion Part Number. When bearing is re-oped the bearing should be marked as expansion for future reference.

BEARING MAXIMUM TOTAL EXPANSION TABLE

SHAFT SIZE	TOTAL EXPANSION
in.	in.
1 3/8 - 1 1/2	3/16
1 11/16 - 3 7/16	1/4
3 15/16	5/16
4 7/16 - 4 15/16	3/8

WARNING: Because of the possible danger to persons(s) or property from accidents which may result from the improper use of products, it is important that correct procedures be followed: Products must be used in accordance with the engineering information specified in the catalog. Proper installation, maintenance and operation procedures must be observed. The instructions in the instruction manuals must be followed. Inspections should be made as necessary to assure safe operation under prevailing conditions. Proper guards and other suitable safety devices or procedures as may be desirable or as may be specified in safety codes should be provided, and are neither provided by Baldor Electric Company nor are the responsibility of Baldor Electric Company. This unit and its associated equipment must be installed, adjusted and maintained by qualified personnel who are familiar with the construction and operation of all equipment in the system and the potential hazards involved. When risk to persons or property may be involved, a holding device must be an integral part of the driven equipment beyond the speed reducer output shaft.

LUBRICATION INSTRUCTIONS

OPERATION IN PRESENCE OF DUST, WATER OR CORROSION VAPORS

This bearing is factory lubricated with No. 2 consistency lithium complex base grease which is suitable for most applications. However, extra protection is necessary if bearing is subjected to excessive moisture, dust, or corrosive vapor. In these cases, bearing should contain as much grease as speed will permit (a full bearing with consequent slight leakage through the seal is the best protection against contaminant entry).

In extremely dirty environments, the bearing should be purged daily to flush out contaminants. For added protection, it is advisable to shroud the bearing from falling material.

HIGH SPEED OPERATION

At higher operation speeds, too much grease may cause overheating. In these cases, the amount of lubrication can only be determined by experience. If excess grease causes overheating, remove grease fittings and run for ten minutes. This will allow excess grease to escape. Then wipe off excess grease and replace grease fittings.

In higher speed applications, a small amount of grease at frequent intervals is preferable to a large amount at infrequent intervals. However, the proper volume and interval of lubrication can best be determined by experience.

AVERAGE OPERATIONS

The following table is a general guide for normal operating conditions. However, some situations may require a change in lubricating periods as dictated by experience. If the bearing is exposed to unusual operating conditions, consult a reputable grease manufacturer.

Lubrication Guide

Read Preceding Paragraphs Before Establishing Lubrication Schedule

Suggested Lubrication Period in Weeks								
Hours run per day	1 to 250 rpm	251 to 500 rpm	501 to 750 rpm	751 to 1000 rpm	1001 to 1500 rpm	1501 to 2000 rpm	2001 to 2500 rpm	2501 to 3000 rpm
8	12	12	10	7	5	4	3	2
16	12	7	5	4	2	2	2	1
24	10	5	3	2	1	1	1	1

OPERATING TEMPERATURE

Abnormal bearing temperatures may indicate insufficient lubrication. If the housing is too hot to touch for more than a few seconds, check the temperature by applying a thermometer at the top of the pillow block with the thermometer tip surrounded by putty.

Because the thermometer reading will be approximately 10°F lower than the actual bearing temperature, add ten degrees to the reading and compare to the temperature rating of your grease. If the bearing temperature reading is consistent and operating within the recommended limits of your grease, the bearing is operating satisfactorily.

The recommended maximum operating temperature for S-2000 Spherical Roller Bearings is 200 °F.

STORAGE OR SPECIAL SHUT DOWN

If equipment will be idle for some time, before shutting down, add grease to the bearing until grease purges from the seals. This will ensure protection of the bearing, particularly when exposed to severe environmental conditions. After storage or idle period, add fresh grease to the bearing before starting.

SET SCREW TORQUE TABLE

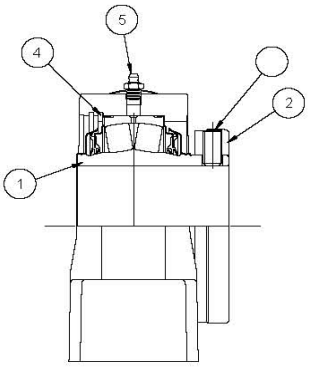
Shaft Size	Socket Set Screw Size	Tightening Torque
1 3/8 - 1 3/4 inches	5/16 inches	165 Inch Pounds
1 15/16 - 2 7/16 inches	3/8 inches	290 Inch Pounds
1 11/16 - 3 7/16 inches	1/2 inches	620 Inch Pounds
1 15/16 - 4 15/16 inches	5/8 inches	1325 Inch Pounds

RECOMMENDED SHAFT TOLERANCE TABLE

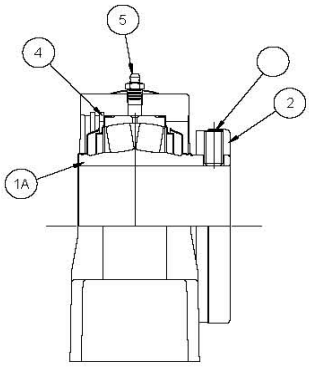
Normal Shaft Size	Low to Normal Equivalent Load and Catalog Speed*	
Up to 1 1/2 inches	+.000 inches	–.0005 inches
Over 1 1/2 to 2 1/2 inches	+.000 inches	–.001 inches
Over 2 1/2 to 4 inches	+.000 inches	–.001 inches
Over 4 to 5 inches	+.000 inches	–.0015 inches

On severe applications and where dynamic balance and minimum runout are important, a snug to light press fit may be required to obtain optimum bearing performance. Consult factory.

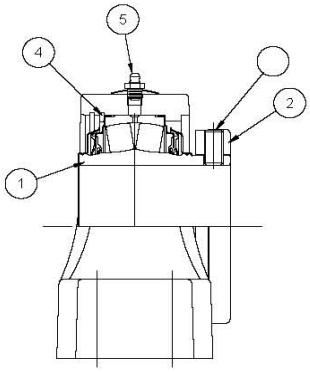
*Normal equivalent load .08C to .18C.



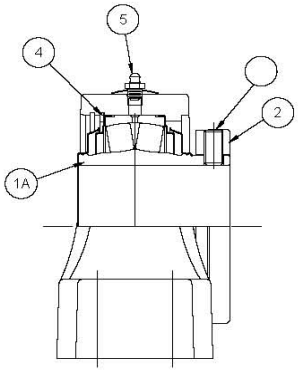
2 BOLT PILLOW
BLOCK S2000-R



2 BOLT PILLOW
BLOCK S2000-L



4 BOLT PILLOW
BLOCK S2000-R



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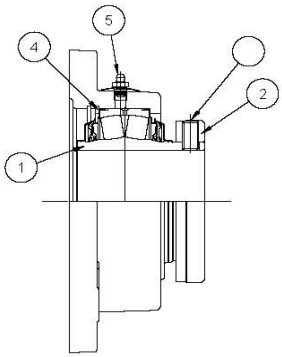
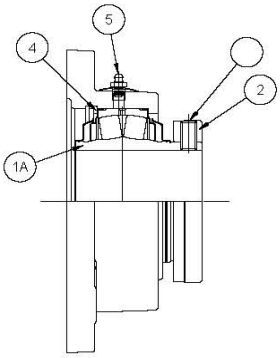
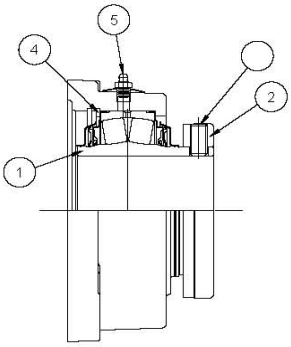
BLOCK S2000-L



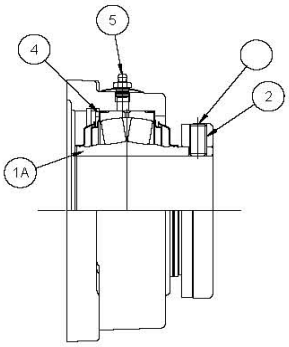
3 & 4 BOLT ROUND
FLANGE S2000-R



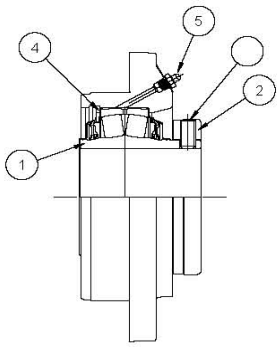
3 & 4 BOLT ROUND
FLANGE S2000-L



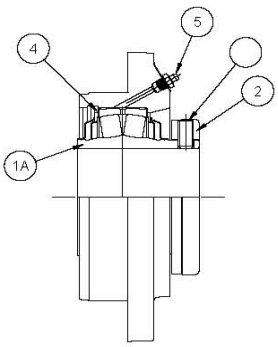
4 BOLT SQUARE
FLANGE S2000-R



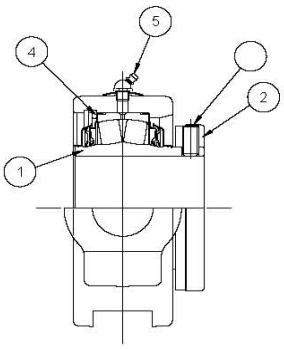
4 BOLT SQUARE
FLANGE S2000-L



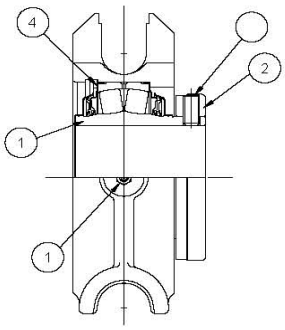
PILOTED FLANGE
S2000-R



PILOTED FLANGE
S2000-L



WIDE SLOT TAKE-UP
S2000-R



TPHU TAKE-UP
S2000-R

COMPONENT PART NUMBERS (1 3/8" - 4 15/16")

ITEM	1	1A	2	3	4	5
Shaft Size Size	Bearing Insert Assembly (R) Seal	Bearing Insert Assembly (L) Seal	* Collar	* Set Screw	Snap Ring	** Grease Fitting
1 3/8	070000	070016	040050	400058	069276	405015
1 7/16	070001	070017	040050	400058	069276	405015
1 1/2	070002	070018	040050	400058	069276	405015
1 11/16	070003	070019	040051	400058	069277	405015
1 3/4	070004	070020	040051	400058	069277	405015
1 15/16	070005	070021	070587	400094	069278	405015
2	070006	070022	070587	400094	069278	405015
2 3/16	070007	070023	070588	400094	069279	405015
2 7/16	070008	070024	040054	400094	069280	405015
2 11/16	070009	070025	070589	400150	069281	405015
2 15/16	070010	070026	070589	400150	069281	405015
3	070011	070027	070589	400150	069281	405015
3 7/16	070012	070028	040056	400154	069282	405015
3 15/16	070013	070029	060946	400186	069283	405015
4 7/16	070014	070030	* 060947	* 400186	069284	405015
4 15/16	070015	070031	* 040059	* 400190	069285	405015
QTY/PER	1	1	1	2	1	1

*Shaft sizes 4 7/16" - 4 15/16" have two collars a

** WSTU and TPHU TU take a 405016 grease fitting.

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This material is not intended to provide operational instructions. Appropriate instruction manuals and precautions should be studied prior to installation, operation or maintenance of equipment.

APPENDIX L

REXNORD **Mounted Roller Bearings**

Installation Instructions 2000, 5000, 9000 Series

(See other side for Bearing Kit Replacement and Maintenance Instructions) **(See separate sheet for 3000 install)**

BEARING MOUNTING PROCEDURE

SET COLLAR-FIXED UNITS ONLY (2000, 5000)

1. Inspect shaft size (see shaft tolerance table). Clean shaft and mounting surface as needed
2. Position bearings on the shaft, applying all driving pressure to the face of the inner ring
3. Align the bearing housing to its mounting base by measuring from the face of the inner ring to the face of the threaded cover. Where shimming is required – use full shims across the housing base – not just at the bolt holes. All four measurements must be within .060" inches of one another
4. Bolt housing securely to mounting base
5. Tighten the set collar set screws on the bearing closest to the drive (or most important to axial position of shaft) to the shaft. Proper tightening torque can be found in the SET SCREW TORQUE TABLE. **The remaining bearings should not be secured to the shaft at this time.** Alternate torquing the screws to prevent unequal loading. If an Allen wrench is used as a torque wrench, place a length of pipe over the long end and pull until the wrench begins to twist.
6. Rotate the shaft under power to permit the remaining bearings to seek their natural running position on the shaft.
7. Shut off the power and torque down set screws in remaining bearings using procedure in Step 5

SET COLLAR-EXPANSION UNITS ONLY (2000, 5000)

1. Center cartridge in outer housing. If maximum expansion capability is required, place cartridge in extreme position of housing to permit full movement of the cartridge in direction of expansion
2. The remainder of the installation is the same as Fixed units, following steps 3,4, and 5

ADAPTER UNITS (9000)

1. Free tapered split sleeve in bore by backing off locknut and rapping the face of the locknut
2. Position bearing on shaft with fixed unit closest to drive (or most important to axial location of shaft)
3. Position and loosely bolt housing to mounting base.
4. Secure fixed bearing to shaft by tightening locknut until sleeve grips the shaft. Tighten locknut ½ to ¾ more and bend one of the lock washer tangs into one of the slots on the outside diameter of locknut
5. Align each bearing housing as accurately as possible to its mounting base or frame by measuring from the face of the inner ring to the face of the threaded cover. All four measurements must be within .060 inches of one another
6. Operate bearing under full load for several days to permit seating of bearing and sleeve on the shaft. Then shut down the system and retighten locknuts on all bearings

ADAPTER UNITS- EXPANSION UNITS ONLY (9000)

1. Center cartridge in outer housing. If maximum expansion capability is required, place cartridge in extreme position of housing to permit full movement of the cartridge in direction of expansion.
2. The remainder of the installation is the same as Fixed units, following steps 2, 3,4, 5 and 6

DUPLEX UNITS (ZD)

When mounting Duplex units, place end plate (bolted cover with pilot) into bore of housing. Press first outer ring until it seats against the pilot, then insert inner ring assembly and turn to free rollers. Press in second outer ring, turn inner ring assembly so rollers are free, and then seat second outer ring. Using shims as a feeler, determine exact amount required to fill space between housing face and bolted cover. See ADJUSTMENT TABLE and add shims to obtain proper bearing clearance. After unit is bolted together, free the bearing by pressing or striking inner ring on the side opposite the shim adjustment

GENERAL INSTALLATION COMMENTS

1. Shaft Journal areas must be free of burrs, cleaned of fretting corrosion and within the tolerance range shown in the SHAFT TOLERANCE TABLE.
2. Mounted units are prelubricated at the factory with multipurpose lithium soap grease. No additional grease is required at time of installation.
3. Position housings for
   a. Accessibility of grease fittings
   b. If thrust is present – place thrust force against shoulder of housing, not against threaded cover side
4. If spacer shims are used for alignment they must cover the entire housing base
5. Spot drill or mill flats on shaft for increased holding power of set screws or ease of removal
6. When a eccentric load condition exists, position set screws directly opposite from eccentric weight
7. Shaft shoulders are recommended for support vertical shafts and high thrust loads. The shoulder diameter should not exceed the outside diameter of the inner ring
8. When pillow blocks are mounted on an inclined plane or the work force is parallel with the base, either lateral bolts or welded stop blocks should be used to prevent shifting
9. Avoid direct hammer blows to the bearing and its components by using a soft drift or block
10. New seals should be used whenever a bearing is rebuilt

SET SCREW TORQUE TABLE

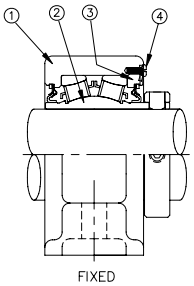
Shaft Size (Inches)		Set Screw Size	Tightening Torque (Inch- Pounds)
Normal Duty 2000 Series	Heavy Duty 5000 Series		
3/4 – 1 1/4	…..	5/16	185
1 7/16 - 2	1 7/16 – 1 15/16	3/8	325
2 3/16 – 2 1/4	2 – 2 3/16	7/16	460
2 3/8 – 3 1/2	2 7/16 – 3 7/16	1/2	680
3 11/16 - 4	3 11/16 – 5 7/16	5/8	1350
…..	5 15/16 – 7	3/4	1600

For more detailed instructions refer to latest REXNORD Catalog

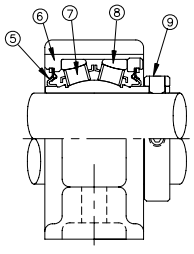
SHAFT TOLERANCE TABLE - INCHES

Nominal Shaft sizes	Commercial Shaft Tolerance* (Cold Finished Steel, Low Carbon)	RECOMMENDED SHAFT TOLERANCES*		
		Set Collar Mounting Severe Loading or High Speed	Adapter Mounting	Press Fit Mounting
1-2	+.000 -.003	+.000 -.001	+.000 -.003	Consult Rexnord
2-4	+.000 -.004	+.000 -.001	+.000 -.004	
4-6	+.000 -.005	+.000 -.0015	+.000 -.005	
6-8	+.000 -.006	+.000 -.0015	+.000 -.005	

*Recommended shaft tolerances are generally satisfactory for loads up to 15% of C (see load ratings in catalog). High load applications will require a press fit to the shaft.



FIXED



FLOATING

1. Housing
2. Inner Race
3. Threaded Cover
4. Microlock Assembly
5. Seal
6. Cartridge
7. Roller
8. Outer Ring
9. Set Collar

Mounted Roller Bearings

Bearing Replacement and Maintenance Instructions

(See other side for installation instructions)

DISASSEMBLY

1. Remove set collars or other shaft locking device
2. Remove seals
3. Remove MICROLOCK screw and key. (Do not loose nylon washer)
4. Remove threaded cover by turning counter clockwise
5. Place housing threaded cover side down on arbor press with spacer blocks under housing
6. Place a soft metal bar or wood block on face of inner ring and press bottom outer ring and inner ring assembly from housing
7. To remove the back outer ring, large bore bearings 4 7/16" thru 7" have drive pin holes. The back outer ring of smaller size units may be removed with a bearing puller or hammer and drift.

REASSEMBLY

1. Place housing cover side up on arbor press with spacer blocks under housing.
2. Press in back outer ring and seat against housing shoulder.
3. Insert inner ring assembly and rotate to seat rollers against back outer ring.
4. Press in front outer ring.
5. Install threaded cover, turning clockwise until inner ring resists rotation or misalignment.
6. Back off threaded cover one quarter turn – align cover slot with the nearest counter bored hole in housing. See ADJUSTMENT TABLE.
7. Install microlock key with nylon washer under the head of the screw.
8. **Using a soft drift or block, rap face of inner ring on side opposite threaded cover to seat front outer ring. Inner ring assembly should rotate freely.**
9. Install seals. **Z-Seal –** Place centering spring in seal groove with fingers facing up. Place U-shaped element on fingers. Place centering ring on element with projection on face up. Install snap ring so that projection on centering ring is between ends of snap ring. **K-Seal –** Place seal into the seal groove with anti rotation boss sticking up. Install snap ring so that the raised boss is between the snap ring ends. **M-Seal –** Place seal into seal groove with spring facing out. No snap ring is required with **M-Seal.**
10. Install collars
11. Lubricate bearing with amount of grease shown in LUBRICATION TABLE. Rotate inner ring assembly during lubrication to assure distribution of grease in bearing

LUBRICATION INSTRUCTIONS

GENERAL INFORMATION AND SELECTION

This information is to aid in the proper lubrication of Rexnord bearings for the majority of applications. Standard bearings come pre-lubricated from the factory with Exxon Ronex MP grease. Exxon Ronex MP is an N.L.G.I. Grade 2. EP (extreme pressure) grease with a lithium complex thickener. It can be used for high loads, and in some cases at temperatures as low as -40°F or as high as +350°F. For high speeds, other special service conditions, or for inquires on other acceptable greases, please consult your local Rexnord representative or the Rexnord Bearing Engineering Department. When rebuilding Rexnord bearings for use in average operating conditions, the bearing should be lubricated with the amount of grease by weight as shown in the LUBRICATION TABLE.

RELUBRICATION

Bearings should be re-lubricated at regular intervals. The frequency and amount of lubricant will be determined by the type of service. General guidelines for re-lubrication frequency and amount are based upon average application conditions. See LUBRICATION TABLE

At High temperatures, greases tend to degrade more rapidly and thus require fresh grease more frequently. In general, small amounts of grease added frequently provide better lubrication. Most grease will eventually harden, causing re-lubrication to become less effective. When this occurs, the bearing should be disassembled, cleaned and lubricated per LUBRICATION TABLE. When equipment will not be in operation for some time, grease should be added to provide corrosion protection. This is particularly important for equipment exposed to severe weather.

AUTOMATIC LUBRICATION SYSTEMS

A variety of automatic re-lubrication systems are available for use with roller bearings. Key considerations are:

1. NLGI grade of grease used, consistent with system layout
2. An amount/frequency combination necessary to replenish the grease

MIXING OF GREASES

Mixing of any 2 greases should be checked with the lubricant manufacturer. If the grease bases are different they should never be mixed

OIL LUBRICATION

Rexnord housing designs do not include oil sumps, thus they are not readily used with static oil lubrication. However, they can be adapted to recirculating oil systems provided an adequate drain size and proper seals are incorporated

LUBRICATION TABLE

SHAFT SIZE - INCHES			GREASE WT. REQUIRED (OZ)		RECOMMENDED NUMBER OF MONTHS BEWEEN RELUBRICATION* (BASED ON 40 HR. WK.)					
					RPM					
Single Collar 2000, 3000 Series	Double Collar 5000 Series	Adapter 9000 Series	To Lubricate Rebuilt Units	To Relubricate Units	100	300	500	1000	1750	3000
3/4 -1	……	……	0.4	0.1						
1 1/8 – 1 1/4	……	……	0.5	0.1	12	8	5	2	1	1/2
1 7/16 – 1 1/2	1 7/16	……	0.6	0.1						
1 11/16 -1 3/4	1 1/2 – 1 11/16	……	0.8	0.2						
1 15/16 -2	1 15/16	……	0.9	0.2						
2 3/16 – 2 1/4	2 – 2 3/16	1 15/16 – 2	1.1	0.2	8	5	3	1	1/2	…..
2 3/8 - 2 1/2	2 7/16	2 3/16	1.5	0.3						
2 11/16 – 3	2 1/2 – 2 15/16	2 7/16 – 2 1/2	2.8	0.5						
3 3/16 – 3 1/2	3 3/16 – 3 7/16	2 11/16 -3	3.7	0.6						
3 11/16 – 4	3 11/16 – 4	3 3/16 – 3 7/16	6.9	1.1	6	4	2	1	1/2	…..
……	4 3/16 – 4 1/2	3 11/16 – 4	8.4	1.5						
……	4 15/16 – 5	4 3/16 – 4 7/16	14.3	2.5						
……	5 7/16	4 15/16 – 5	22.1	4.0						
……	5 15/16 – 6	5 3/16 – 5 7/16	25.3	4.5	4	2	1	1/2	…..	…..
……	6 7/16 - 7	5 15/16 – 6 7/16	33.0	6.0						

***Relubrication amounts and frequencies shown in the table are based on standard clearance, moderate loads, etc., which yield housing temperatures of 150°F or less. Lubrication practices indicate that the relubrication frequency should be doubled for every 20°f above that level**

ADJUSTMENT TABLE (AXIAL AND RADIAL CLEARANCES)

Size Code	SHAFT SIZE (INCHES)				FACTORY ADJUSTMENT (Average Speeds)		RECOMMENDED ADJUSTMENT HIGH SPEEDS			CLEARANCE ADJUSTMENT INCHES PER 1/12 TURN	
	2000 SERIES	3000 SERIES	5000 SERIES	9000 SERIES	STD AXIAL CLEARANCE	STD RADIAL CLEARANCE	SPEED OVER	AXIAL CLEARANCE	RADIAL CLEARANCE	AXIAL	RADIAL
2-4	3/4 – 1 1/2	1 7/16	1 7/16	……	.007-.012	.0022-.0037	2000	.012-.017	.0037-.0053	0.005	0.0016
5-6	1 11/16 - 2	1 11/16 – 1 15/16	1 1/2 – 1 15/16	……	.007-.012	.0020-.0034	1500	.012-.017	.0034-.0049	0.005	0.0014
7-9	2 3/16 – 3	2 3/16 – 2 15/16	2 – 2 15/16	1 15/16 – 2 1/2	.010-.017	.0026-.0044	1250	.017-.024	.0044-.0062	0.007	0.0018
10-11	3 3/16 - 4	3 7/16 – 3 15/16	3 3/16 - 4	2 11/16 -3 7/16	.010-.017	.0025-.0043	1000	.017-.024	.0043-.0060	0.007	0.0018
12-13	……	……	4 3/16 – 5	3 11/16 – 4 7/16	.015-.025	.0032-.0054	750	.025-.035	.0054-.0076	0.010	0.0022
14-16	……	……	5 7/16 - 7	4 15/16 – 6 7/16	.015-.025	.0032-.0054	500	.025-.035	.0054-.0076	0.010	0.0022

Rexnord Industries, LLC
Bearing Group

Phone: 317-273-5500
www.rexnord.com

105-99501-07
ECN 5-43431
5-12-08

(This sheet provides install information for the 3000 series, see 2000, 5000, 9000 sheet for more info)

Twist Lock™ 3000 Series Roller Bearing

This bearing is equipped with an eccentric locking set collar that should be tightened in the direction of shaft rotation

BEARING MOUNTING PROCEDURE

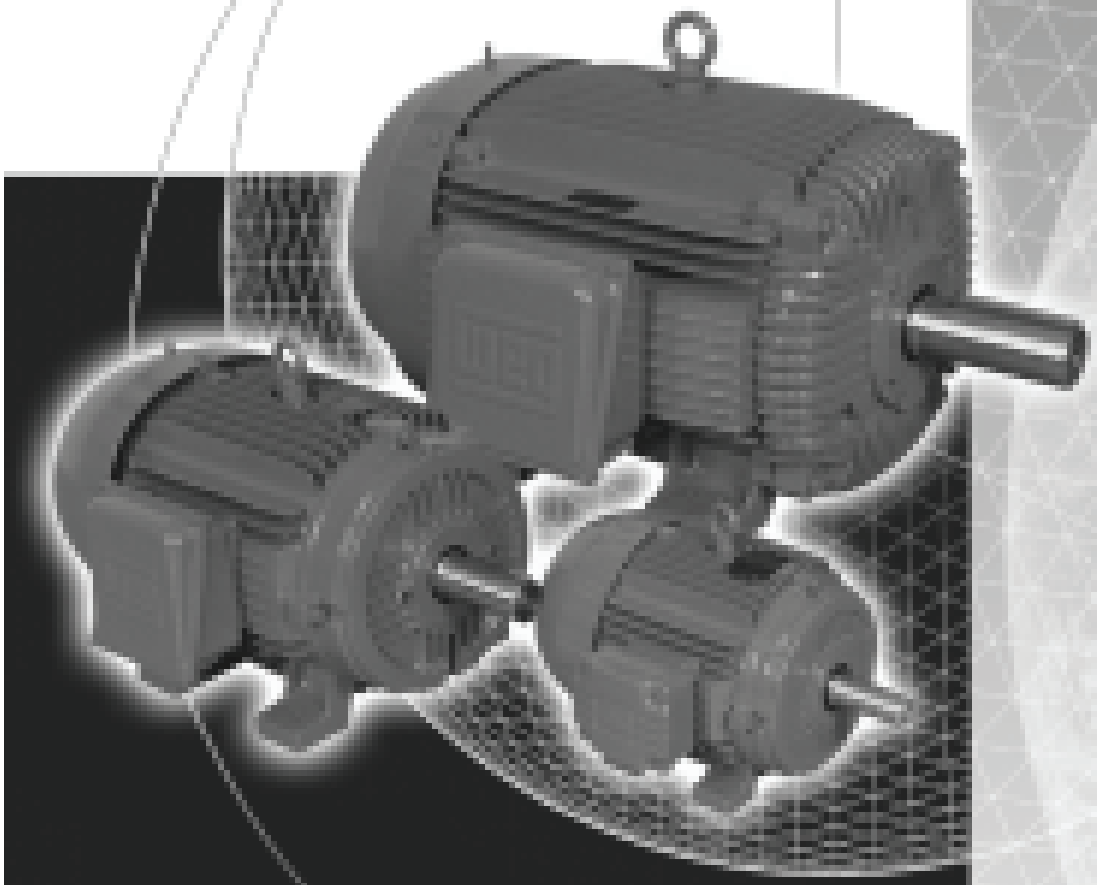
8. Position bearings on the shaft, applying the driving pressure to the face of the inner ring.
9. Align the bearing housing to its mounting base by measuring from the face of the inner ring to the face of the threaded cover. Where shimming is required – use full shims across the housing base – not just at the bolt holes. All four measurements must be within .060" inches of one another
10. Bolt housing securely to mounting base
11. Slide collar over the shaft until it nests over the cam of the inner ring. Do this on the bearing closest to the drive (or the most important to axial position of shaft). Rotate the collar in the direction of normal shaft rotation until snug. Utilizing a hammer and punch, rotate the collar until tight. Tighten set screws securely. Utilize torque values from the SET SCREW TABLE PER "SET SCREW SIZE". If an Allen wrench is used as a torque wrench, place a length of pipe over the long end and pull until the wrench begins to twist.
12. **The remaining bearings should not be secured to the shaft at this time**
13. Rotate the shaft under power to permit the remaining bearings to seek their natural running position on the shaft.
14. Shut off the power and torque down set screws in remaining bearings using procedure in Step 4.

BEARING REMOVAL PROCEDURE

7. Use a hammer and punch to rotate the collar in the direction opposite the shaft rotation until it loosens. If the rotation direction is unknown, look for prior punch marks on the collar. Then rotate the collar in the opposite direction until it loosens.
8. Remove the collar from the shaft of the and inner ring. The bearing may now be removed from the shaft. To eliminate bearing damage, apply all driving force to the face of the inner ring.

APPENDIX M

MOTORS AND DRIVES



INSTALLATION AND MAINTENANCE INSTRUCTIONS FOR ELECTRIC MOTORS

Frames 143/5T - 586/7T

QUALITY SYSTEM ISO9001 WEG MOTORES

BVQI ISO 9001

READ CAREFULLY THIS MANUAL BEFORE INSTALLING THE MOTOR.

RECEIVING CHECK

- ✓ Check if any damage has occured during transportation.
- ✓ Check nameplate data.
- ✓ Remove shaft locking device (if any) before operating the motor.
- ✓ Turn the shaft with the hand to make sure if it is turning freely.

HANDLING AND TRANSPORTATION

1 - General

MOTORS MUST NOT BE LIFTED BY THE SHAFT, BUT BY THE EYE BOLTS WHICH ARE PROPERLY DESIGNED TO SUPPORT THE MOTOR WEIGHT.

Lifting devices, when supplied, are designed only to support the motor. If the motor has two lifting devices then a double chain must be used to lift it.

Lifting and lowering must be done gently without any shocks, otherwise the bearings can get damaged.

DURING TRANSPORTATION, MOTORS FITTED WITH ROLLER OR ANGULAR CONTACT BEARINGS ARE PROTECTED AGAINST BEARING DAMAGES WITH A SHAFT LOCKING DEVICE.

THIS LOCKING DEVICE MUST BE USED ON ANY FURTHER TRANSPORT OF THE MOTOR, EVEN WHEN THIS MEANS TO UNCOPULE THE MOTOR FROM THE DRIVEN MACHINE.

STORAGE

If motors are not immediately installed, they must be stored in dry places, free of dust, vibrations, gases, corrosive smokes, under constant temperature and in normal position free from other objects.

In case the motors are stored for more than two years, the bearings must be changed or the lubrication grease must be totally replaced after cleaning.

Single phase motors when kept in stock for 2 years or more must have their capacitors replaced (if any).

We recommend to turn the shaft (by hands) at least once a month, and to measure the insulation resistance before installing it, in cases of motors stored for more than 6 months or when subject to high humidity areas.

If motor is fitted with space heaters, these should be switched on.

Insulation Resistance Check

Measure the insulation resistance before operating the motor and/or when there is any sign of humidity in the winding.

The resistance measured at 25°C (77 °F) must be:

Ri > (20 x U) / (1000 + 2P) [Mohm] (measured with a MEGGER at 500 V d.c.); where U = voltage (V); P = power (kW).

If the insulation resistance is less than 2 megaohms, the winding must be dried according to the following:
✓ Warm it up inside an oven at a minimum temperature of 80°C (176 °F) increasing 5°C (41 °F) every hour until 105°C (221 °F), remaining under this temperature for at least one hour. Check if the stator insulation resistance remains constant within the accepted values. If not, stator must be reimpregnated.

INSTALLATION

1 - Safety

All personnel involved with electrical installations, either handling, lifting, operation or maintenance must be well informed and up-to-dated concerning the safety standard and principles that govern the work and carefully follow them.

We strongly recommend that these jobs are carried out by qualified personnel.

MAKE SURE THAT THE ELECTRIC MOTORS ARE SWITCHED OFF BEFORE STARTING ANY MAINTENANCE SERVICE.

Motors must be protected against accidental starts.

When performing any maintenance service, disconnect the motor from the power supply. Make sure all accessories have been switched off and disconnected.

Do not change the regulation of the protecting devices to avoid damaging.

LEAD CONNECTION IN SULATION INSIDE THE TERMINAL BOX MUST BE DONE WITH AN INSULATING MATERIAL COMPATIBLE WITH MOTOR THERMAL CLASS WHICH IS SHOWN ON THE MOTOR NAMEPLATE.

2 - Operating Conditions

Electric motors, in general, are designed for operation at an altitude of 1000m above sea level for an ambient temperature between 25°C (77°F) and 40°C (104°F). Any variation is stated on the nameplate.

COMPARE THE CURRENT, VOLTAGE, FREQUENCY, SPEED, OUTPUT AND OTHER VALUES DEMANDED BY THE APPLICATION WITH THE DATA GIVEN ON THE NAMEPLATE.

Motors supplied for hazardous locations must be installed in areas that comply with that specified on the motor nameplate.

KEEP AIR INLET AND OUTLET FREE AND CLEAN. THE AIR BLOWN OUT BY THE MOTOR SHALL NOT ENTER AGAIN. THE DISTANCE BETWEEN THE AIR INLET AND THE WALL MUST BE AROUND ¼ OF THE INLET OPENING DIAMETER.

3 - Foundation

Motors provided with feet must be installed on though foundations to avoid excessive vibrations.

The purchaser is fully responsible for the foundation.

Metal parts must be painted to avoid corrosion.

The foundation must be uniform and sufficiently tough to support any short circuit strengths. It must be designed in such a way to stop any vibration originated from resonance.

4 - Drain Holes

Make sure the drains are placed in the lower part of the motor when the mounting configuration differs from that specified on the motor purchase order.

5 - Balancing

WEG MOTORS ARE DYNAMICALLY BALANCED, WITH HALF KEY AT NO LOAD AND UNCOUPLED.

Transmission elements such as pulleys, couplings, etc must be dynamically balanced with half key before installation. Use always appropriate tools for installation and removal.

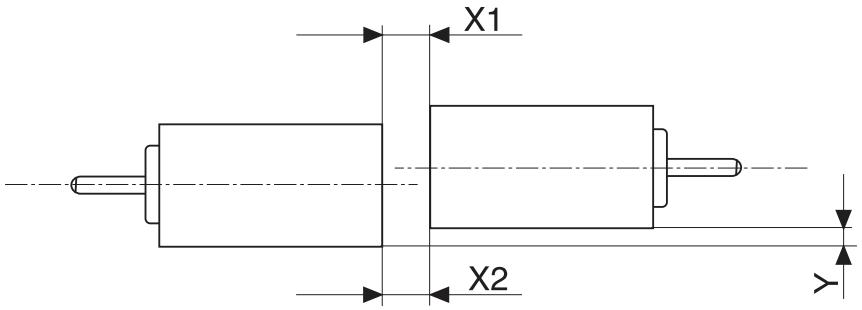
6 - Alignment

ALIGN THE SHAFT ENDS AND USE FLEXIBLE COUPLING, WHENEVER POSSIBLE.

Ensure that the motor mounting devices do not allow modifications on the alignment and further damages to the bearings.

When assembling a half-coupling, be sure to use suitable equipment and tools to protect the bearings.

Suitable assembly of half-coupling: check that clearance Y is less than 0.05mm and that the difference X1 to X2 is less than 0.05m as well.



Note: The“X” dimension must be at least 3mm.

7 - Belt Drive

When using pulley or belt coupling the following must be observed:

✓ Belts must be tighten just enough to avoid slippage when running, according to the specifications stated on the belt supplier recommendation.

WARNING:
Excessive tension on the pulleys will damage the bearings and lead to a probable shaft rupture.

8 - Connection

WARNING: V oltage may be connected at standstill inside the terminal box for heating elements or direct winding heating.

WARNING : The capacitor on single-phase motors can retain a charge which appears across the motor terminals, even when the motor has reached standstill.

A WRONG CONNECTION CAN BURN THE MOTOR.

Voltage and connection are indicated on the nameplate. The acceptable voltage variation is ± 10%, the acceptable frequency variation is ± 5% and the total acceptable variation is ± 10%.

9 - Starting Methods

The motor is rather started through direct starting. All Weg motors must be connected as shown on the motor nameplate, failure to follow the motor nameplate could lead to motor failure.

In case this is not possible, use compatible methods to the motor load and voltage.

✓ 3 lead single voltage and 9 lead dual voltage motors can be started as follows:
Full Voltage Direct On Line.
Auto-Transformer Starting.
Electronic Soft-Starting.
VFD Starting - subject to verification and application analysis.

✓ 6 lead single voltage motors and 12 lead dual voltage motors can be connected as follows:
Full Voltage Direct On Line.
WYE/DELTA Starting.
Auto-Transformer Starting.
Electronic Soft-Starting.
VFD Starting - subject to verification and application analysis.

The rotation direction is clockwise if the motor is viewed from DE side and if the phases are connected according to the sequence L1, L2, L3.

To change the rotation direction, interchange two of the connecting leads.

THE CONNECTION TO THE POWER SUPPLY MUST BE DONE BY QUALIFIED PERSONNEL AND WITH FULL ATTENTION TO ASSURE A SAFE AND PERMANENT CONNECTION. AFTER CONNECTING THE MOTOR, CHECK FOR ANY STRANGE BODY INSIDE THE TERMINAL BOX. THE CABLE INLETS NOT IN USE MUST BE CLOSED.

Make sure to use the correct cable dimension, based on the rated current stamped on the motor nameplate.

BEFORE ENERGIZING THE TERMINALS, CHECK IF THE EARTHING IS MADE ACCORDING TO THE ACTUAL STANDARDS. THIS IS ESSENTIAL AGAINST ACCIDENT RISKS.

When the motor is supplied with protective or monitor temperature device such as thermostats, thermistors, thermal protector, etc, connect their terminals to the corresponding devices on the control panel.

10- Start-Up

THE KEY MUST BE FASTENED OR REMOVED
BEFORE STARTING THE MOTOR.

a) The motor must start and operate smoothly. In case this does not occur, turn it off and check the connections and the mounting before starting it again.

b) If there is excessive vibration, check if the fastening screws are correctly fastened. Check also if the vibration comes from a neighbour machine. Periodical vibration checks must be done.

c) Run the motor under rated load for a short period of time and compare if the running current is equal to that stamped on the nameplate.

MAINTENANCE

WARNING:
SAFETY CHECK LIST.

1 - General Inspection

- ✓ Check the motor periodically.
- ✓ Keep the motor clean and assure free air flow.
- ✓ Check the seals or V Ring and replace them, if required.
- ✓ Check the connections as well as supporting screws.
- ✓ Check the bearings and observe:
  Any excessive noise, bearing temperature and grease condition.
- ✓ When a changing, under normal conditions, is detected, check the motor and replace the required parts.
  The frequency of the inspections depends on the motor type and on the application conditions.

LUBRICATION

FOLLOW THE REGREASING INTERVALS. THIS IS FUNDAMENTAL FOR PROPER MOTOR OPERATION.

1 - Machines without Grease Nipples

Motors up to frame 324/6T are normally fitted without grease nipples. In these cases the regreasing shall be done at the preventive maintenance job observing the following aspects:

- ✓ Disassemble carefully the motors.
- ✓ Take all the grease out.
- ✓ Wash the bearing with querosene or diesel.
- ✓ Regrease the bearing immediately.

2 - Machines Fitted with Grease Nipples

It is strongly recommended to grease the machine while running. This allows the grease renewal in the bearing housing. When this is not possible due to turning parts by the grease device (pulleys, bushing, etc) that offer some risk to the physical integrity of the operator, proceed as follows:

- ✓ Clean the area near to the grease nipple.
- ✓ Put approximately half of the total grease and run the motor for 1 minute at full speed. Then turn off the motor and pump the rest of the grease.
- ✓ The injection of all the grease with the motor in standstill can make the grease penetrate into the motor, through the inner seal of the bearing housing.

When regreasing, use only special bearing grease with the following properties:

RELUBRICATION INTERVALS RECOMMENDED - POLYREX® EM GREASE (ESSO/EXXON)

Frame	Amount of grease (g)	3600 rpm	3000 rpm	1800 rpm	1500 rpm	1200 rpm	1000 rpm	900 rpm	750 rpm	720 rpm	600 rpm	500 rpm
Relubrication intervals in hours - ball bearings												
254/6T	*13*	*15700*	*18100*	*20000*	*20000*	*20000*	*20000*	*20000*	*20000*	*20000*	*20000*	*20000*
284/6T	*18*	*11500*	*13700*	*20000*	*20000*	*20000*	*20000*	*20000*	*20000*	*20000*	*20000*	*20000*
324/6T	*21*	*9800*	*11900*	*20000*	*20000*	*20000*	*20000*	*20000*	*20000*	*20000*	*20000*	*20000*
364/5T	*27*	*3600*	*4500*	*9700*	*11600*	*14200*	*16400*	*17300*	*19700*	*20000*	*20000*	*20000*
404/5TS	*27*	*3600*	*4500*	*9700*	*11600*	*14200*	*16400*	*17300*	*19700*	*20000*	*20000*	*20000*
444/5TS	*27*	*3600*	*4500*	*9700*	*11600*	*14200*	*16400*	*17300*	*19700*	*20000*	*20000*	*20000*
504/5TS	*27*	*3600*	*4500*	*9700*	*11600*	*14200*	*16400*	*17300*	*19700*	*20000*	*20000*	*20000*
586/7TS	*27*	*3600*	*4500*	*9700*	*11600*	*14200*	*16400*	*17300*	*19700*	*20000*	*20000*	*20000*
Relubrication intervals in hours - cylindrical roller bearings												
324/5T	*21*	*9800*	*11900*	*20000*	*20000*	*20000*	*20000*	*20000*	*20000*	*20000*	*20000*	*20000*
364/5T	*27*			*9700*	*11600*	*14200*	*16400*	*17300*	*19700*	*20000*	*20000*	*20000*
404/5T	*34*			*6000*	*7600*	*9500*	*11600*	*13800*	*15500*	*15500*	*17800*	*20000*
444/5T	*45*			*4700*	*6000*	*7600*	*9800*	*12200*	*13700*	*13700*	*15700*	*20000*
447/5T	*45*			*4700*	*6000*	*7600*	*9800*	*12200*	*13700*	*13700*	*15700*	*20000*
504/5T	*45*			*4700*	*6000*	*7600*	*9800*	*12200*	*13700*	*13700*	*15700*	*20000*
586/7T	*60*			*3300*	*4400*	*5900*	*7800*	*10700*	*11500*	*11500*	*13400*	*17300*

WARNING:

The table above is specifically intended for relubrication with Polyrex ® EM grease and bearing absolute operating temperature of:

✓ 70 °C (158 °F) for 254/6T to 324/6T frame motors;
✓ 85 °C (185 °F) for 364/5T to 586/7T frame motors.

For every 15 °C (59 °F) above these limits, relubrication interval must be reduced by half.

Shielded bearing (ZZ) are lubricated for berings life as long as they operate under normal ambient conditions and temperature of 70°C(158 °F).

WE RECOMMEND TO USE BALL BEARINGS FOR MOTORS DIRECTLY COUPLED TO THE LOAD.

WARNING:
EXCESS OF GREASE CAN CAUSE BEARING OVERHEATING RESULTING IN COMPLETE DAMAGE.

Compatibility of P olyrex® EM grease with other types of grease:

Containing polyurea thickener and mineral oil, the Polyrex® EM grease is compatible with other types of grease that contain:

- ✓ Lithium base or complex of lithium or polyurea and highly refined mineral oil;
- ✓ Inhibitor additive against corrosion, rust and anti-oxidant additive.

Notes:

- ✓ Although Polyrex® EM is compatible with the types of grease given above, we do no recommend to mix it with any other greases.
- ✓ If you intend to use a type of grease different than those recommended above, first contact WEG.
- ✓ On applications (with high or low temperatures, speed variation, etc), the type of grease and relubrication interval are given on an additicional nameplate attached to the motor.
- ✓ Vertical mounted motors must have the relubrication intervals reduced by half.

THE USE OF STANDARD MOTORS IN SPECIFIC AREAS OR SPECIAL APPLICATIONS MUST BE DONE BY CONSULT TO THE GREASE MANUFACTURER OR WEG.

ASSEMBLY AND DISASSEMBLY

Disassembly and assembly must be done by qualified personnel using only suitable tools and appropriated methods. The stator grips must be applied over the side face of the inner ring to be disassembled or over and adjacent part.

It is essential that the bearings disassembly and assembly be done under cleanning conditions to ensure good operation

and to avoid damages. New bearings shall only be taken out from their cases when assembling them.

Before installing a new bearing it is required to check the shaft fitting for any sharp edge or strike signals.

For bearing assembly, warm their inner parts with suitable equipment - inductive process - or use suitable tools.

SPARE PARTS

When ordering spare parts, please specify the full type designation and product code as stated on the motor nameplate.

Please also inform the motor serial number stated on the nameplate.

MOTORS FOR HAZARDOUS LOCATIONS

Besides the recommendations given previously, these ones must be also followed:

THE SPECIFICATION OF THE MOTOR INSTALLATION PLACE IS FOR CUSTOMER'S RESPONSIBILITY, WHO WILL ALSO DETERMINE THE ENVIRONMENT CHARACTERISTICS.

Motors for hazardous locations are manufactured according to specific standards for such environments and they are certified by worldwide certifying entities.

1 - Installation

The complete installation must follow procedures given by the local legislation in effect.

THE INSTALLATION OF HAZARDOUS LOCATION MOTORS MUST BE CARRIED OUT BY SKILLED PEOPLE, AND THE THERMAL PROTECTION MUST BE ALWAYS INSTALLED, EITHER INSIDE OR OUTSIDE THE MOTOR, OPERATING AT THE RATED CURRENT.

2 - Maintenance

Maintenance must be carried out by repair shops authorized by WEG.

Repair shops and people without WEG's authorization who will perform any service or hazardous location motors will be fully responsible for such service as well as for any consequential damage.

ANY ELECTRICAL OR MECHANICAL MODIFICATION MADE ON HAZARDOUS LOCATION MOTORS WILL VOID THE CERTIFICATION.

When performing maintenance, installation or relubrication, follow these instructions:

- ✓ Check if all components are free of edges, knocks or dirt.
- ✓ Make sure all parts are in perfect conditions.
- ✓ Lubricate the surfaces of the endshield fittings with protective oil to make the assembly easier.
- ✓ Use only rubber hammer to fit the parts.
- ✓ Check for correct bolts tightening.
- ✓ Use clearance calibrator for correct T-box fitting (smaller than 0.05mm).

DO NOT REUSE DAMAGED OR WORN PARTS. REPLACE THEM BY NEW ONES SUPPLIED BY THE FACTORY.

MOTORS DRIVEN BY VFD

Applications using VFD´s without filter can affect motor performance as follows:

- ✓ Lower efficiency.
- ✓ Higher vibration.
- ✓ Higher noise level.
- ✓ Higher rated current.
- ✓ Higher temperature rise.
- ✓ Reduced motor insulation.
- ✓ Reduced bearing life.

1 - Standard Motors

- ✓ Voltages lower than 440V do not require filter.
- ✓ Voltages equal or higher than 440V or lower than 575V require filter for motor power supply cables longer than 20 meters.
- ✓ Voltages equal or higher than 575V require filter for any size of power supply cables.

IF SUCH RECOMMENDATIONS ARE NOT FOLLOWED ACCORDINGLY, MOTOR WARRANTY WILL BE VOID.

2 - Inverter Duty Motors

- ✓ Check power supply voltage of the forced cooling set.
- ✓ Filters are not required.

WARRANTY TERMS
SERIES AND ENGINEERING PRODUCTS

WEG warrants its products against defects in workmanship and materials for 18 months from the invoice date issued by the factory, authorized distributor or agent limited to 24 months from manufacturing date independent of installation date as long as the following items are fulfilled accordingly:

- Proper transportation, handling and storage;
- Correct installation based on the specified ambient conditions and free of corrosive gases;
- Operation under motor capacity limits;
- Observation of the periodical maintenance services;
- Repair and/or replacement effected only by personnel duly authorized in writing by WEG;
- The failed product be available to the supplier and/or repair shop for a required period to detect the cause of the failure and corresponding repair;
- Immediate notice by the purchaser about failures occured and that these are accepted by WEG as manufacturing defects.

This warranty does not include disassembly services at the urchaser facilities, transportation costs with product, tickets, accomodation and meals for technical personnel when requested by the customer. The warranty service will be only carried out at WEG Authorized Repair Shops or at WEG´s facilities.

Components whose useful life, under normal use, is shorter than the warranty period are not covered by these warranty terms.

The repair and/or replacement of parts or components, when effected by WEG and/or any WEG Authorized Repair Shop, will not give warranty extension.

This constitutes WEG´s only warranty in connection with this sale and the company will have no obligation or liability whatsoever to people, third parties, other equipment or installations, including without limitation, any claims for consequential damages or labor costs.

APPENDIX N

SERVICE RECOMMENDATIONS
FOR MASABA HUDRAULIC SYSTEMS (PUMPS & TANKS)

Daily Inspection:

With the conveyor down check hydraulic fluid level, Add an ISO-30 oil if required.

Inspect all hoses, inspect for any rubbing and or cracking-replace if needed.

Inspect entire machine for any hydraulic leaks-repair if needed.

Inspect cooler to make sure it is free of any type of debris, clean if required.

Check main system pressure is at 3,000 PSI- if pressure is not please contact MASABA for further instructions.

6 Month Inspection/Maintenance:

Loosen love joy coupling and slide back to inspect rubber spider, Replace if worn.

Remove and replace hydraulic filter.

Inspect cylinders and motors for any leaks at the shafts-remove and repair if required.

12month maintenance:

Pressure wash any debris from power unit.

Drain hydraulic oil from tank, remove clean out cover and wipe out tank with clean non-lint bearing rags.

Install clean out cover, fill with oil.

MASABA
MINING EQUIPMENT

APPENDIX P

ALLIED OIL & SUPPLY, INC.

2209 S. 24th Street
Omaha, NE 68108
402-344-4343
800-333-3717
FAX: 402-344-4360

MATERIAL SAFETY DATA SHEET

IDENTITY (As used on label and list): **ALLIED AW HYDRAULIC OIL ISO 32, GROUP I**

PRODUCT CODE: **900AN0032BU**

NFPA Hazard Identification 0 – Least 1 – Slight 2– Moderate 3 – High 4 - Extreme

Health: 0 **Fire: 1** **Reactivity: 0**

Section I - General Information

Allied Oil & Supply, Inc.
2209 S. 24th Street
Omaha, NE 68108
Information (402) 344-4343

Emergency/ Chemtrec **(800) 424-9300** Reviewed: **12/29/03**

Section II - Composition/Information on Ingredients

COMPONENT NAME	%	CAS	OSHA PEL	ACGIH TLV
Lubricating Oil Base Stock	95-99	**MIXTURE**	5mg/m3*	5mg/m3*
Proprietary Additives	1-5	**MIXTURE**	5mg/m3*	5mg/m3*

*Numbers are for oil mist.

No IARC, NTP, OSHA and ACGIH listed carcinogens

Section III - Hazards Identification

EYE CONTACT: Contact with eyes may cause eye irritation.

SKIN CONTACT: Prolonged or repeated contact may result in skin irritation or dermatitis.

INHALATION: Breathing oil mist in concentrations that exceed the TLV and PEL may result in respiratory discomfort and irritation.

INGESTION: Although this product is not expected to be acutely toxic, aspiration of liquid into the lungs during ingestion or vomiting may cause chemical pneumonitis.

CARCINOGENICITY: This product has not been classified as a carcinogen or probable carcinogen by OSHA, NTP, or IARC.

SIGNS AND SYMPTOMS OF OVEREXPOSURE: May cause skin, eye, or respiratory irritation.

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE: None recognized

OTHER HEALTH INFORMATION: None

Section IV - First Aid Procedures

EYE CONTACT: If splashed into eyes, flush with water for 15 minutes or until irritation subsides. Get medical attention if irritation persists.

SKIN CONTACT: Remove contaminated clothing. Wash skin thoroughly with soap and water. Get medical attention if irritation persists.

INHALATION: If overcome by vapor from hot product, immediately remove victim to fresh air. If breathing has stopped, administer artificial respiration. Call for medical attention. If overexposed to oil mist, remove from further exposure.

INGESTION: DO NOT induce vomiting, call medical attention immediately.

Section V - Fire and Explosion Hazard Data

Flash Point (deg F): > 425 Method Used: COC
Flammable or Explosive Limits (approximate % by volume in air) LEL: n/a UEL: n/a

EXTINGUISHING MEDIA: Use water spray, dry chemical, foam, or carbon dioxide. Use water to keep fire-exposed containers cool. Water spray may be used to flush spills away from exposures.

SPECIAL FIRE FIGHTING PROCEDURES: Self-contained breathing apparatus may be required.

UNUSUAL FIRE AND EXPLOSION HAZARDS: None known

Section VI - Accidental Release Measures

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: Add sand, earth, or other suitable absorbent to spill area. Keep product out of sewers and waterways by damming or impounding.

Section VII - Handling and Storage

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE: Store in a cool, dry place with adequate ventilation. Do not expose to extreme temperatures or flames.

OTHER PRECAUTIONS: None

Section VIII - Exposure Controls/Personal Protection

RESPIRATORY PROTECTION: Use supplied-air respiratory protection in confined or enclosed space, if needed.

VENTILATION: Use local exhaust to capture vapor, mists or fumes, if necessary. Provide ventilation sufficient to prevent exceeding recommended exposure limit or buildup of explosive concentrations of vapor in air. Use explosion-proof equipment.

PROTECTIVE GLOVES: Use neoprene gloves, if needed, to avoid prolonged or repeated skin contact.

EYE PROTECTION: Wear goggles if there is likelihood of contact with eye(s).

OTHER PROTECTIVE EQUIPMENT: Use neoprene apron or other clothing, if needed, to avoid prolonged or repeated skin contact.

WORK PRACTICES/ENGINEERING CONTROL: Keep containers closed when not in use.

PERSONAL HYGIENE: Wash skin thoroughly after contact, before breaks and meals, and at the end of the work period. Thoroughly clean contaminated clothing, including shoes, before re-use.

Section IX- Physical/Chemical Characteristics

Boiling Point (deg F): n/a
Specific Gravity (H_2O=1): .876
Vapor Pressure (mm Hg): n/a
Melting Point (deg F): ND
Vapor Density (Air=1): n/a
Solubility in Water : insoluble
Evaporation Rate (n-butyl Acetate=1): n/a

APPEARANCE AND ODOR: Light amber liquid, mild petroleum odor.

Section X - Reactivity Data

STABILITY: Stable

INCOMPATIBILITY (MATERIALS TO AVOID): Strong oxidants such as liquid chlorine, concentrated oxygen, sodium hypochlorite or calcium hypochlorite.

HAZARDOUS DECOMPOSITION OR BYPRODUCTS: Carbon monoxide, aldehydes, and other petroleum decomposition products. Oxides of sulfur, phosphorus, calcium, zinc, and hydrogen sulfide may also be present.

HAZARDOUS POLYMERIZATION: Will not occur

CONDITIONS TO AVOID: None

Section XI - Toxicological Information

See Section IV

Section XII - Ecological Information

Section XIII - Disposal Considerations

WASTE DISPOSAL METHOD: Place in an appropriate disposal facility in compliance with local regulations.

Section XIV - Transport Information

NOT A REGULATED ITEM ACCORDING TO DOT.

Section XV-Regulatory Information

SARA SECTION 313: This product does not contain greater than 1.0% (greater than 0.1% for carcinogenic substances) of any chemical substance listed under SARA Section 313.
WHMIS classification for product: This product has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR.

This material safety data sheet and the information it contains is offered to you in good faith as accurate. We have reviewed any information contained in the data sheet which we received from sources outside our company and we believe that information to be correct, but cannot guarantee its accuracy or completeness. Health and safety precautions in this data sheet may not be adequate for all individuals and/or situations. It is the user's obligation to evaluate and use this product safely and to comply with all applicable laws and regulations. No statement made in this data sheet shall be construed as permission or recommendation for the use of any product in a manner that might infringe existing patents. No warranty is made, either expressed or implied.